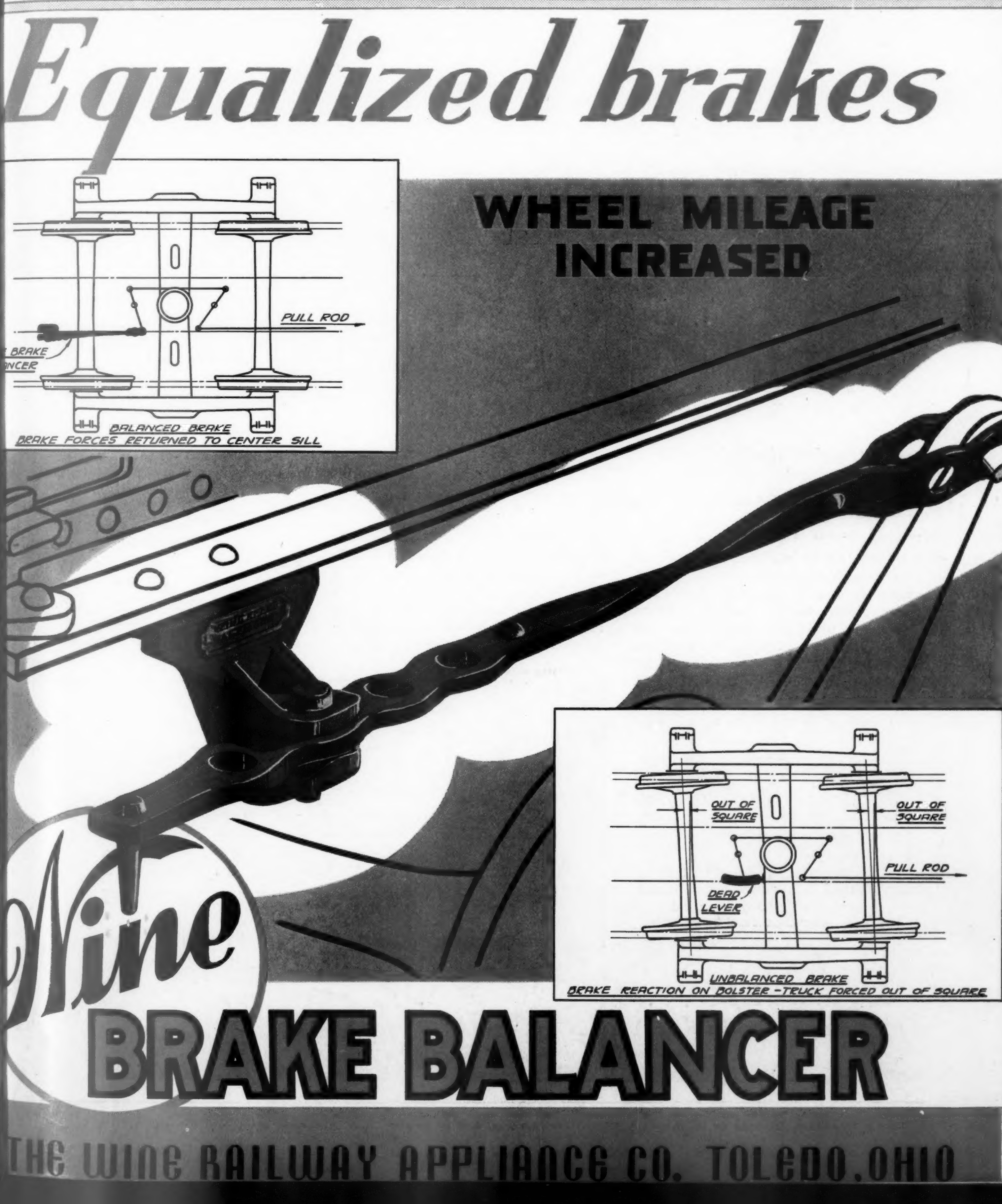
Railway Mechanical Engineer

February
1941

FOUNDED IN 1832



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See page 45

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Western Maryland Buys

4-6-6-4 Type Locomotives

Baldwin Locomotive Works now delivering 12 articulated locomotives which develop 95,500 lb. tractive force, have 5,770 sq. ft. of combined heating surface, and 118.8 sq. ft. grate area—These locomotives are replacing 2-10-0 type between Hagerstown and Connellsville

DELIVERIES of 12 4-6-6-4 single-expansion articulated freight locomotives are now being made to the Western Maryland by the Baldwin Locomotive Works. These locomotives are going into service between Hagerstown, Md., and Connellsville, Pa., a line 171.4 miles long. These locomotives develop 95,500 lb. tractive force, with driving wheels 69 in. in diameter. They have a combined heating surface of 5,770 sq. ft. and carry a working pressure of 250 lb. per sq. in. The four cylinders are 22 in. diameter by 32 in. stroke.

The line over which the new locomotives will operate is one of severe grades, particularly in the westerly direction. From Hagerstown 103 miles west to the summit of a 23-mile grade of 1.75 per cent, there is a difference of elevation of about 2,875 ft. Eastbound from Connellsville the grade is not so severe. It is a steady climb, however, ending with 13 miles of 0.8 per cent grade, and there is a difference of elevation between Connellsville and the summit of over 2,100 ft. in about 68 miles. Approaching Hagerstown there is 7 miles of 1.1 per cent ascending grade.

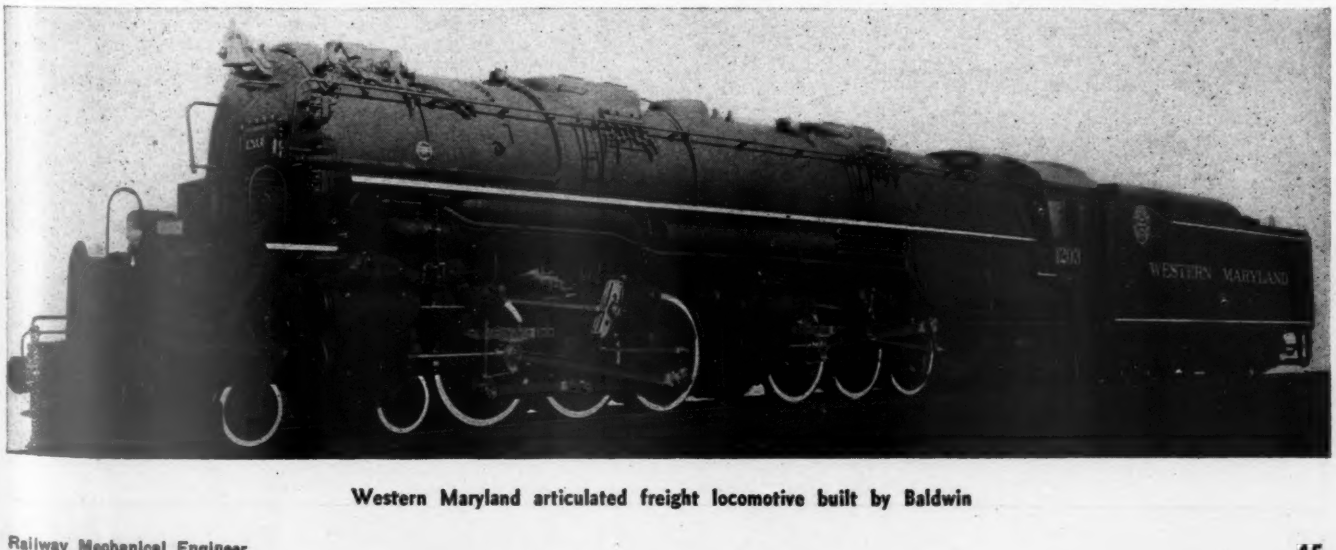
The Boiler

There are several points of interest in the design of the boilers of these locomotives. The firebox is of unusually large dimensions and is supplemented by a 96-in. combustion chamber. There are three Duplex type Thermic syphons in the firebox and two single-connection syphons in the combustion chamber. The front tube sheet is of two-piece welded construction, riveted in the boiler.

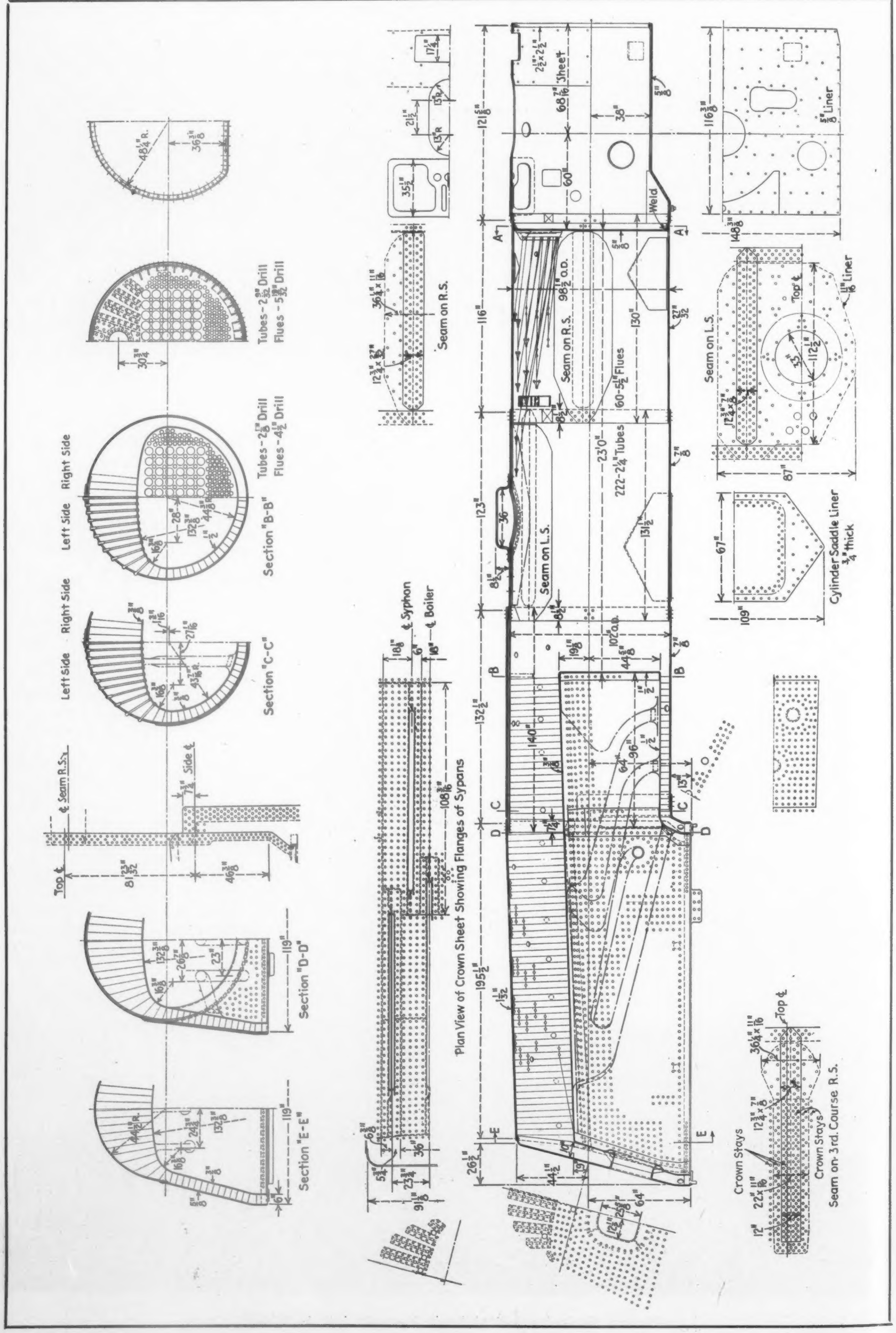
The boiler is straight-top in form with three barrel courses. The barrel and wrapper sheets are of silico-manganese steel. The tubes and flues have a copper content of 0.20 per cent. The inside dimensions at the mud ring are 17 ft. 8⅛ in. by 8 ft. 10¼ in. From the top of the door sheet to the flue sheet the crown sheet is 24 ft. 3⅝ in. in length. Over the front end of this sheet is a Barco low-water alarm.

The grate area is limited to 118.8 sq. ft. by the insertion of a Gaines wall which cuts off at the front end about 4 ft. 3 in. of the length inside the mud ring. This area is closed with a plate and stiffening angles.

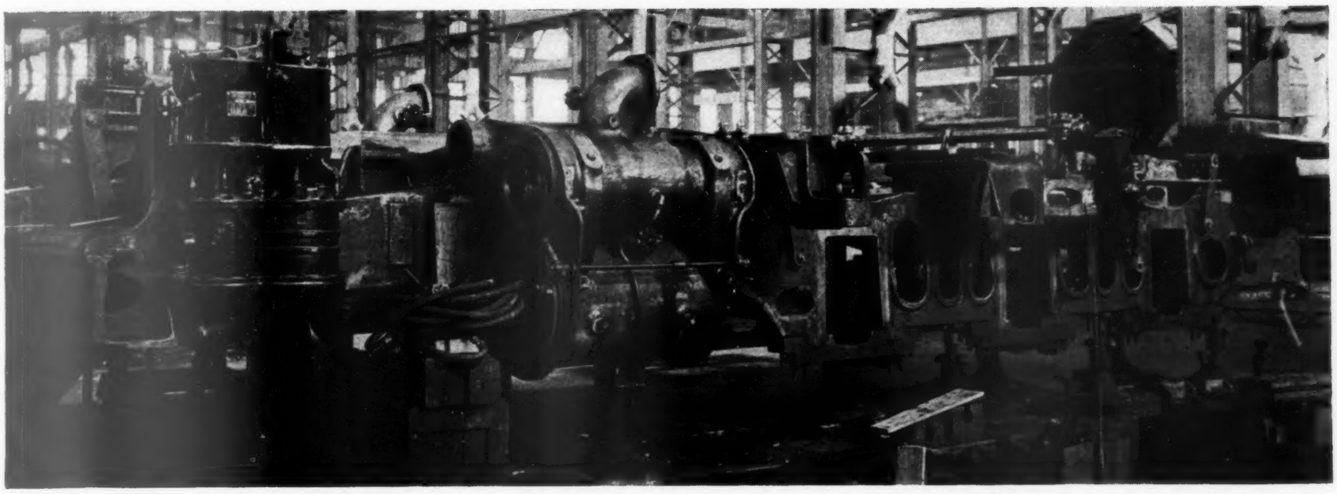
Each of the Duplex Thermic syphons in the firebox has two connections to the water space. All of the rear connections are through the throat sheet. The forward connection of the middle syphon is through the bottom of the combustion chamber; that of each side syphon is through the side sheet of the firebox. The combustion-chamber syphons, which alternate in lateral spacing with



Western Maryland articulated freight locomotive built by Baldwin



Longitudinal and cross sections of the boiler of the Western Maryland articulated locomotive



Assembling the front engine unit

those in the firebox, connect through the bottom of the combustion chamber.

The firebox and combustion chamber are of welded construction. The flange of the firebox tube sheet has a radius of 2 in. at the top, which is gradually reduced to ¾ in. opposite the top outside superheater flue. The firebox sheets are single riveted to the mud ring and the bottom edges of both the inside and outside sheets are seal welded all around.

The vertical wrapper-sheet seams are also seal welded 12 in. up from the bottom. Wherever the presence of the heads of expansion or flexible stays interferes with calking, the edges of the throat and wrapper sheets are also seal welded.

Another interesting application of welding is at the front tube sheet. This is in two parts—the tube sheet proper, which is a flat disc, and a separate rectangular ring in lieu of a flange. The ring is single riveted to the shell and against the inside edge is placed the tube-sheet disc. The latter clears the inside of the shell by ⅛-in. all around and is secured to the ring by a single vee-weld applied in the angle between the two pieces on the smokebox side.

A considerable expanse of flat surface on the front tube sheet beyond the boundaries of the tube layout is in itself unsupported against the boiler pressure partly because of the absence of the flange radius. This area is supported by gussets of ½-in. plate welded to the front of the tube sheet and to the tube-sheet ring. These gussets, of which there are three lengths to suit the distances between the outside tubes and the boiler shell, are shown in the tube-sheet layout as well as on one of the cross-sections of the locomotive.

Another noteworthy detail of the front tube sheet is the combination with the drypipe ring of the four center rows of tube-sheet brace lugs in a single steel casting. The usual tee-section attachments are applied for the three outside rows of braces on each side.

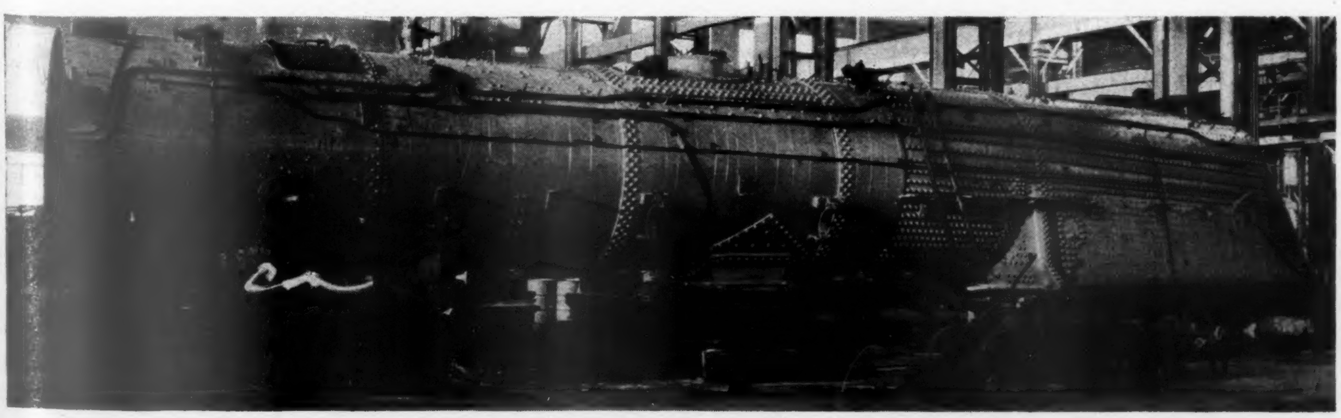
Aside from the first four transverse rows at the front, which are Alco expansion stays, the crown stays are threaded and riveted. Alco flexible stays are applied on the side, back head and throat sheets in the breakage zones and on the curve between crown and side sheets of the combustion chamber. Flannery flexible bolts are applied around the lower half of the combustion chamber.

The superheater is Type A with the American multiple throttle in the header. There is a Tangential steam dryer in the dome. The feedwater heater is the Worthington Type 6½ SA with a capacity of 14,000 gallons per hour. A Hancock Type KNL injector will supply up to 11,000 gallons an hour.

In the fireboxes are Hulson tuyere type grates. Coal is fired by the Standard HT type stoker with the engine mounted in the tender.

Running Gear

The foundation of the front and rear engines of this locomotive are Commonwealth steel bed castings. Cylinders and back cylinder heads are integral parts of these castings. The articulation hinge, located in the front end of the rear bed casting in line with the transverse center



One of the Western Maryland boilers in the erecting shop

line of the cylinders, is of the universal type. A separate hinge casting is pin connected about a horizontal axis at the rear end of the front bed casting and the vertical hinge-pin is fitted with a ball bearing in the hinge casting.

The boiler is supported on the rear unit at the cylinder saddle and at the front and back ends of the firebox. The front firebox supports are expansion shoes supported on the bed castings. The rear support is an expansion plate. On the front unit the weight of the boiler is transferred to the bed casting through a single sliding waist support, free to adjust itself longitudinally with boiler-expansion and contraction and to align itself without distortion under vertical oscillations of the engine bed.

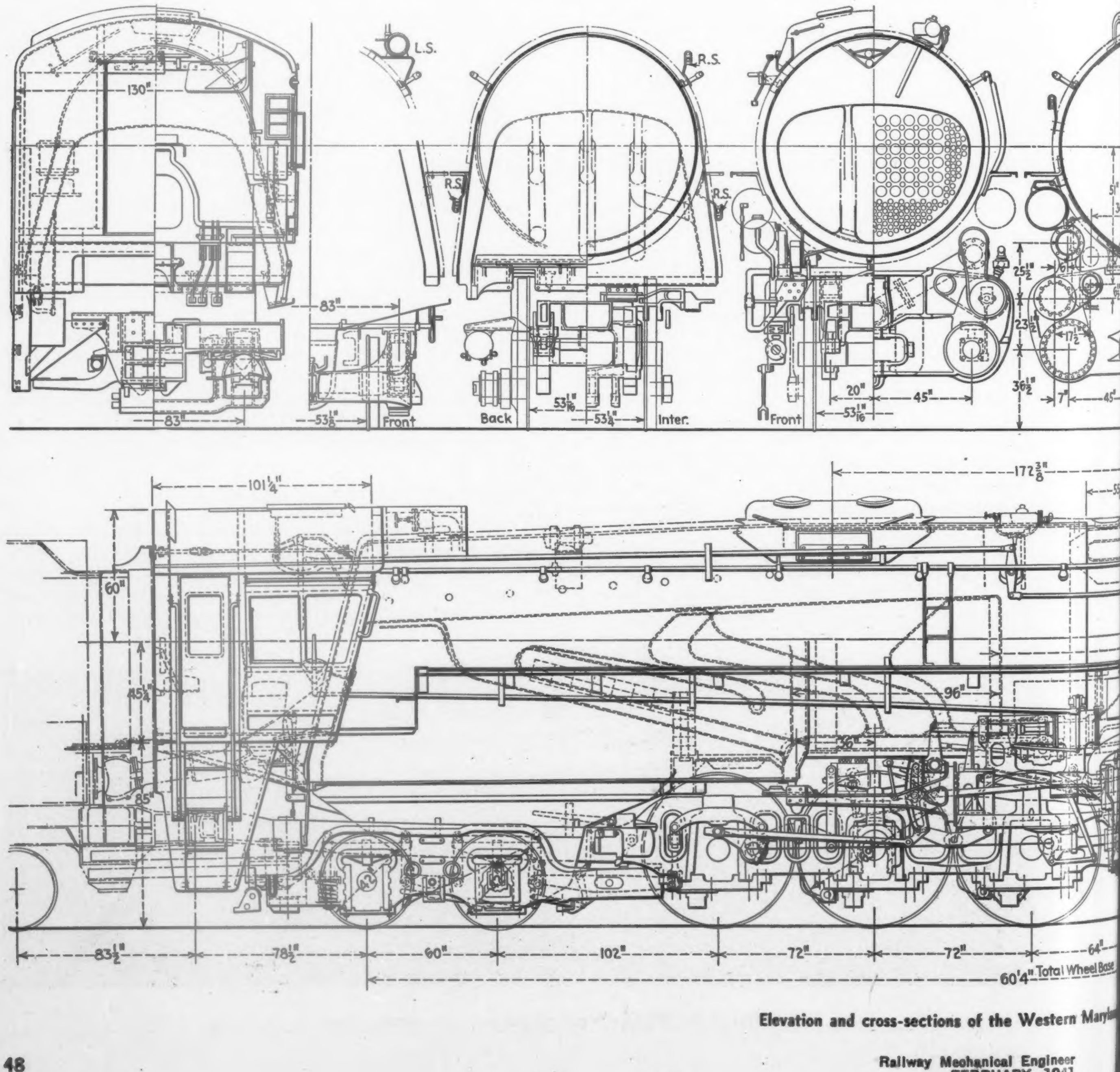
The driving wheels are Baldwin disc type of high-tensile steel. The driving journal boxes are cast steel with bronze crown bearings. The shoe-and-wedge fits and the hub faces of the driving box are bronze. The former are poured on, while the hub faces are ½ in. of welded metal. The driving-box wedges are Franklin compensators and snubbers.

The engine truck is a four-wheel Commonwealth design with inside bearings and rocker-supported swing bolster. The wheels and axles are A. S. F. roller-bearing units. The trailer truck is a Commonwealth four-wheel Delta type. The outside journal bearings are of bronze. Provision has been made so that boosters may be installed later.

Hennessy journal-box lubricators are installed in all driving boxes and trailing-truck boxes. The pump of the driving-journal lubricator is actuated by contact rods,

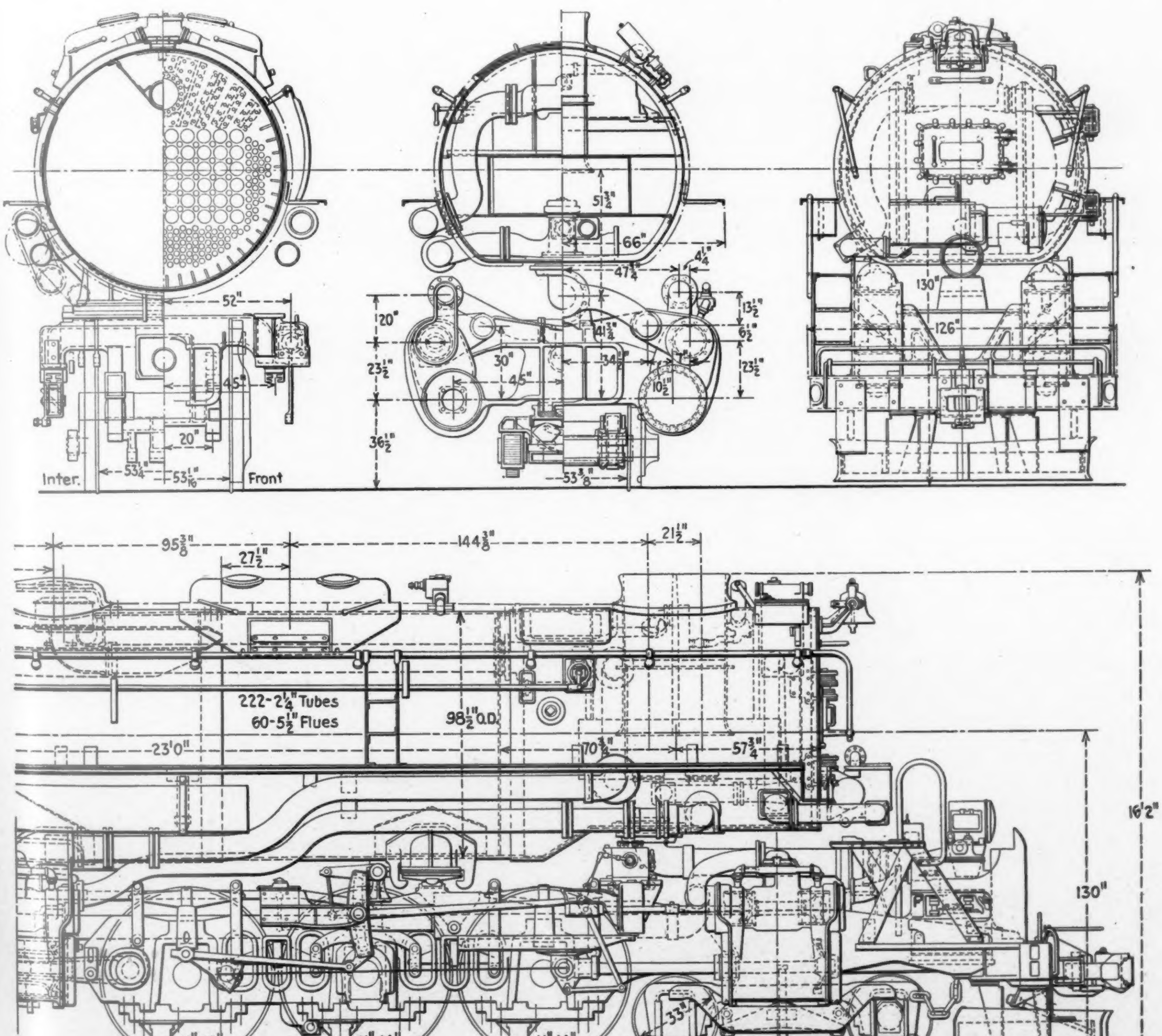
General Dimensions, Weights, and Proportions of the Western Maryland 4-6-6-4 Type Freight Locomotive

Railroad	Western Maryland
Builder	Baldwin
Type of locomotive	4-6-6-4
Road class	M-2
Road numbers	1201-1212
Date built	December, 1940
Service	Fast freight
Dimensions:	
Height to top of stack, ft.-in.	16- 2
Height to center of boiler, ft.-in.	10-10
Width overall, ft.-in.	11- 0
Cylinder centers, in.	90
Weights in working order, lb.:	
On drivers	402,266
On front truck	81,500
On trailing truck	117,234
Total engine	601,000
Tender (two thirds loaded)	338,250

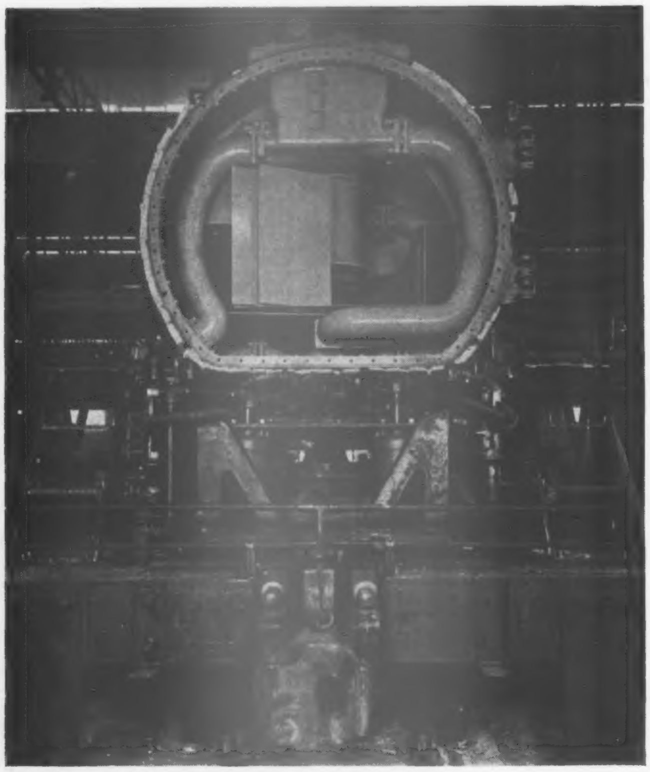


Elevation and cross-sections of the Western Maryl

Wheel bases, ft.-in.:	
Driving	35-3
Rigid	12-0
Engine, total	60-4
Engine and tender, total	106-0
Wheels, diameter outside tires, in.:	
Driving	69
Front truck	33
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	4-22x32
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7½
Steam lap, in.	1⅜
Exhaust clearance, in.	⅛
Lead, in.	5/16
Boiler:	
Type	Straight top
Steam pressure, lb. per sq. in.	250
Diameter, first ring, inside, in.	96 13/16
Diameter, largest, outside, in.	102
Firebox length, in.	212⅛
Firebox width, in.	106¼
Height mud ring to crown sheet, back, in.	72⅝
Height mud ring to crown sheet, front, in.	82¾
Combustion chamber length, in.	96
Thermic syphons, number	5
Tubes, number and diameter, in.	222-2¼
Flues, number and diameter, in.	60-5½
Length over tube sheets, ft.-in.	23-0
Fuel	Soft coal
Grate area, sq. ft.	118.8
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	544
Thermic syphons	252
Firebox, total	796
Tubes and flues	4,974
Evaporative, total	5,770
Superheater	1,735
Combined evap. and superheat.	7,505
Tender:	
Type	Water bottom
Water capacity, gal.	22,000
Fuel capacity, tons	30
Trucks	Six-wheel
Journals, diameter and length, in.	7x14
Rated tractive force, engine, lb.	95,500
Weight proportions:	
Weight on driver ÷ weight engine, per cent	66.93
Weight on drivers ÷ tractive force	4.21
Weight of engine ÷ evaporation	104.16
Weight of engine ÷ comb. heat. surface	80.08
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	10.61
Tube-flue heat. surface per cent comb. heat. surface	66.28
Superheater heat. surface per cent comb. heat. surface	23.12
Firebox heat. surface ÷ grate area	6.70
Tube-flue heat. surface ÷ grate area	41.87
Superheater heat. surface ÷ grate area	14.60
Comb. heat. surface ÷ grate area	63.17
Evaporative heat. surface ÷ grate area	48.57
Tractive force ÷ grate area	803.87
Tractive force ÷ evaporative heat. surface	16.55
Tractive force ÷ comb. heat. surface	12.73
Tractive force × diameter drivers ÷ comb. heat. surface	878.01



4-6-6-4 type articulated locomotives for heavy, fast freight service



Feedwater heater and its steam connections—The double-stack extensions are shown in the background

the ends of which project beyond the end of the cellar and bear against the hub of the wheel. The pump keeps a distributing pad which bears against the under side of the journal flooded with oil while the locomotive is operating. The pump of the trailer journal lubricator is operated by arms, the ends of which bear against the end of the axle. This is the same method of operation employed in the A. A. R. type of lubricator used on the tender.

The piston heads are of forged steel and are fitted with Koppers American sectional cylinder packing of flanged cast-iron and bronze rings of the restrained type. The crosshead and guide have multiple bearing surfaces; the gib is of extruded aluminum. The main and side rods are annealed carbon steel. The side rods have heavy bronze bushings, pressed in. The front-end main-rod bushing is also fixed, while the rod connections on the main pins have floating bronze bushings running in fixed iron bushings. The knuckle pins are casehardened and fitted in casehardened steel bushings.

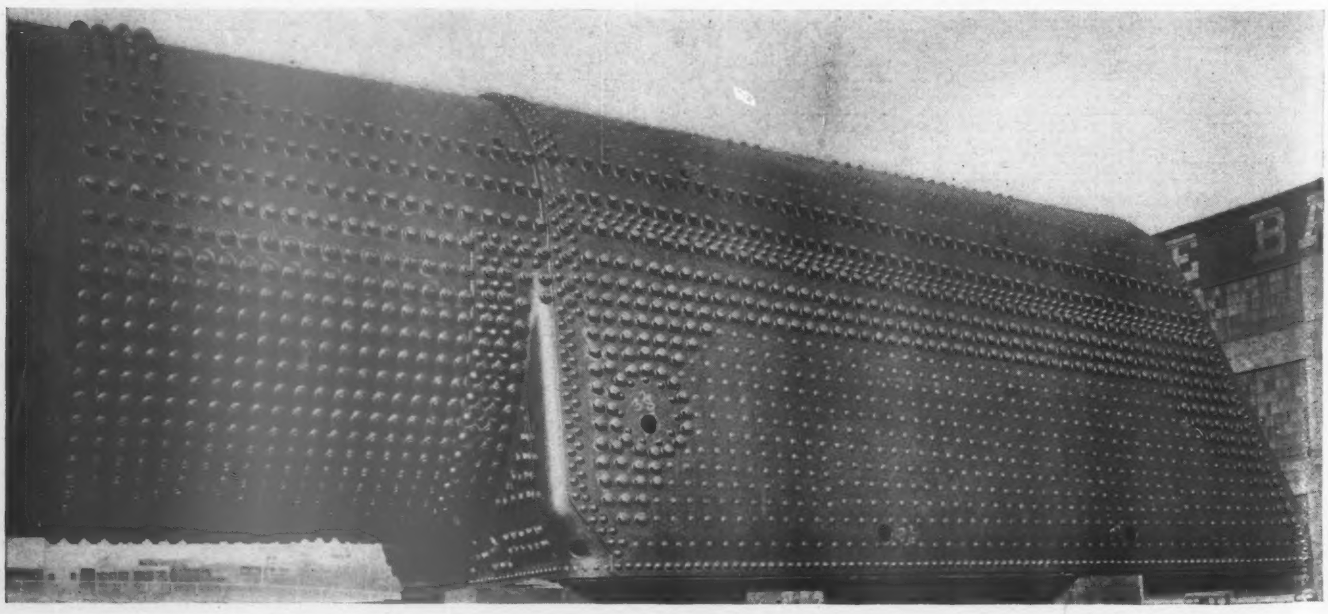
There are no grease cups on the rods. Grease lubrication is applied through the hollow-bored crank pins with pressure fittings in the ends.

The counterbalancing of these locomotives is such that at diametral speed the dynamic augment averages 5,135 lb. per wheel. In determining the weight of reciprocating parts the rotating portion of the main rod weight is calculated by the center-of-percussion method. The main driving wheels are cross-counterbalanced. Reciprocating parts on one side of the locomotive weigh 1,356 lb. on the front unit and 1,236 lb. on the back unit. An overbalance of 100 lb. is added to the counterbalance in each driving wheel, and the unbalanced reciprocating weight is thus 3.31 lb. per 1,000 lb. of locomotive weight.

Steam Distribution System

All cylinders operate on high-pressure steam directly from the boiler. Steam for the cylinders of both units is carried back from the branch pipes in steam pipes which lead to steam-chest connections at the front of each of the rear cylinders. From the back side of these connections pipes lead to a V-connection at the rear of the back cylinder saddle on the longitudinal center line of the locomotive. Steam for the front cylinders is carried forward through the rear cylinder saddle to a single pipe along the longitudinal center line of the front bed casting to a Y-connection behind the front cylinders from which branch pipes lead to the two front steam-chest connections. The two pipes to the rear cylinders terminate in expansion glands at the rear cylinders. A rear section of the single steam pipe to the front cylinders has an expansion joint and ball joints at the ends. The rear ball joint is housed in the front end of the rear cylinder saddle and the front joint in a pocket in the bed casting between the second and third pairs of driving wheels.

The exhaust pipes from the rear cylinder are carried forward along the lower quarter of the boiler to the smokebox. A single exhaust pipe leading from a Y-



The firebox and combustion-chamber staying

connection to the front ends of the forward steam chests is connected to the bottom of the smokebox. Both ends of this pipe have ball joints, and there is an expansion joint at the front end.

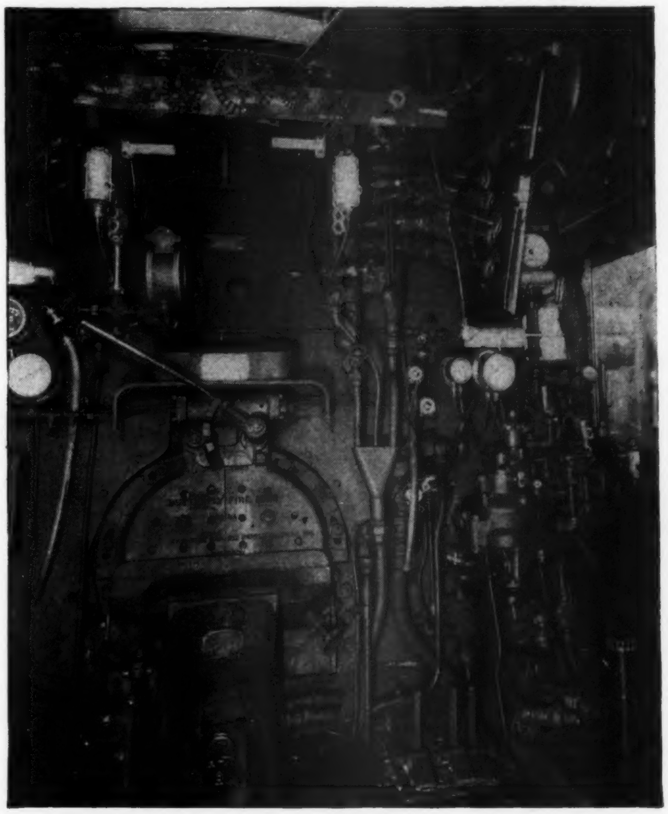
There are two stacks and two exhaust stands, one in front of the other. In order to get as long an exhaust-pipe connection from the front cylinders as possible, to keep the angular movement of the pipe on curves to a minimum, this pipe is carried back to the rear exhaust stand and the rear cylinders exhaust through the front exhaust stand. The exhaust nozzles are of the annular type. A Cyclone spark arrester is installed in the front end.

The locomotives have Walschaert valve motion controlled by an Alco Type H-12 power reverse gear. The reverse gear is supported from the bed casting.

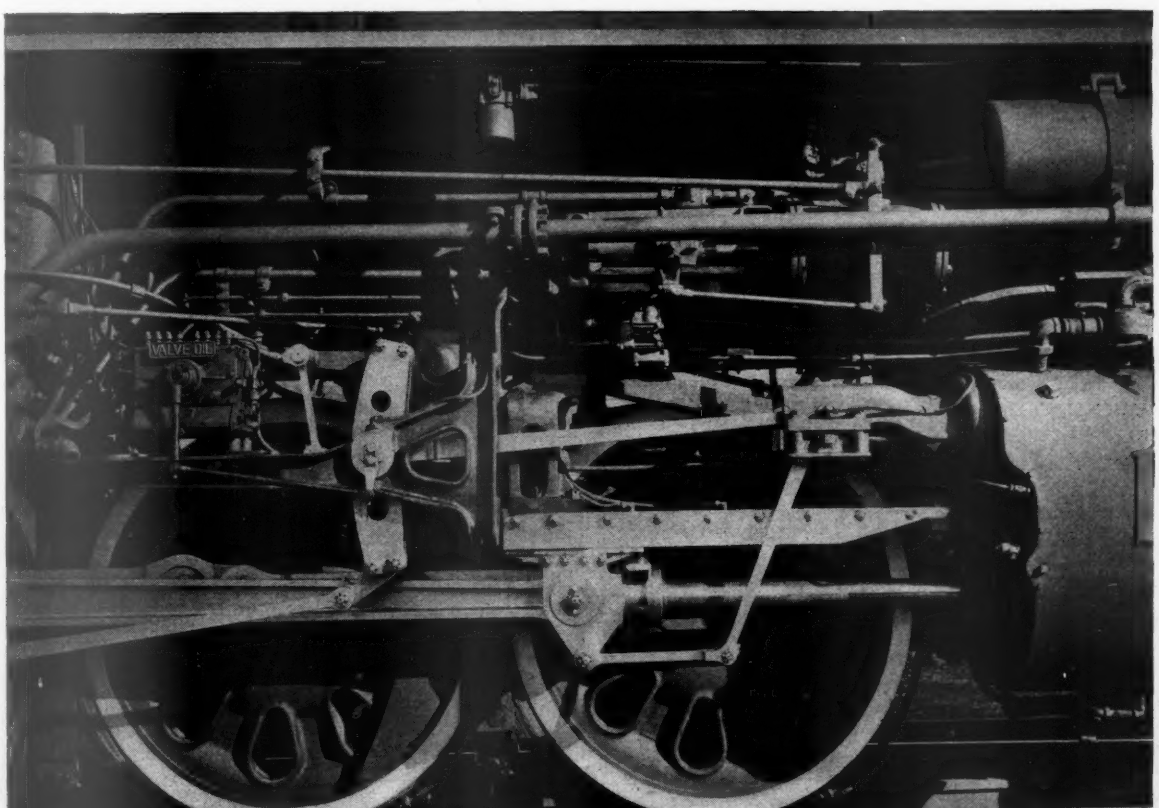
Lubrication

Force-feed oil lubrication has been employed extensively on the chassis of this locomotive. On the left side of each engine unit is a force-feed lubricator for engine oil. On the first six of these locomotives the lubricators are 32-pt. Detroit Model B, with 11 feeds on the front unit and 12 feeds on the rear unit. From these feeds, with one two-way and ten four-way dividers, this lubricator feeds oil to the reverse-link bearings, to the shoe and wedge faces of the six driving boxes, to the front truck pedestals, to the main guides, to the valve-stem guides, and to all driving-wheel hubs. The articulation hinge pins are also oiled from this lubricator. On the rear unit, with one two-way and eleven four-way dividers, similar bearings are lubricated and, in place of the articulation pins, oil is fed to the sliding waist bearer under the front end of the boiler.

Each of the second six locomotives is fitted with a 36-pt. Nathan DV-7 type lubricator on the left side of each unit, with 10 feeds on the front unit and 12 feeds on the rear unit. On these locomotives the hubs of the rear drivers on the front units are oiled from the lubricator on the rear unit.



The cab interior

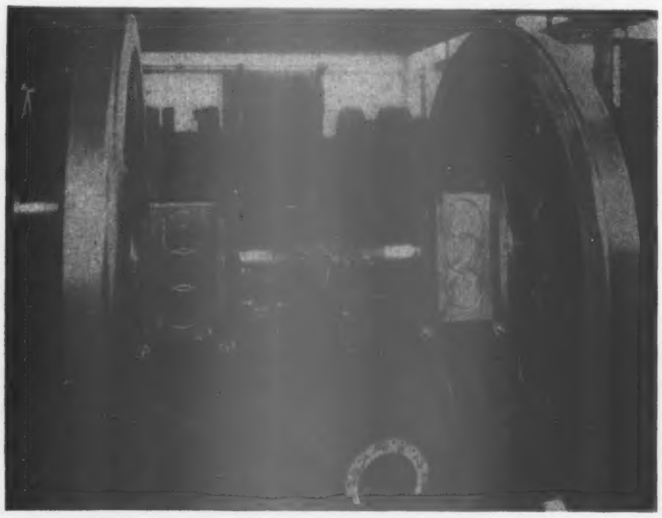


Running gear of the rear unit

On the right side of each engine unit is a mechanical lubricator for valve oil. From each of these lubricators two feeds lead to the cylinders and two to the valves. From the lubricators on both units oil is fed to exhaust-pipe and steam-pipe joints and the lubricator on the rear unit feeds also the stoker engine and the feedwater hot pump.

The valve-oil lubricators on the first six locomotives are 30-pt. Detroit Model A., with Detroit dividers and diaphragm terminal checks, while those on the second six locomotives are 36-pt. Nathan Type DV-7, with Nathan terminal checks. All of the locomotives are equipped with a Detroit 16-pt. mechanical lubricator which feeds flange-oiler shoes on the first pair of drivers on each engine unit.

Alemite grease lubrication is also used extensively on these locomotives. This application includes brake-rig-



From the driving box at the right the Hennessy dust guard has been removed and the oil cellar partially withdrawn from the box

ging pins, crosshead and knuckle pins, drawbar pins, lubricator rigging, spring rigging, power reverse gear, stoker bearings, throttle rigging, the front-truck center

Partial List of Materials and Equipment on the Western Maryland 4-6-6-4 Type Locomotives

Engine bed; engine and trailer trucks	General Steel Castings Corp., Eddystone, Pa.
Engine truck wheels (front)	Bethlehem Steel Co., Bethlehem, Pa.
Driving wheels; trailer-truck wheels; axles; crank pins; connecting rods	Standard Steel Works Co., Burnham, Pa.
Tires, driving-wheel	Midvale Co., Nicetown, Philadelphia, Pa.
Springs	Crucible Steel Co. of America, New York
Automatic compensators and snubbers; radial buffer	Franklin Railway Supply Co., Inc., New York
Uncoupling device	Standard Railway Equipment Company, New York
Coupler; roller bearings (front engine truck)	American Steel Foundries, Chicago
Drawbar	Ewald Iron Co., Louisville, Ky.
Bearing metal—driving boxes, rods, etc.	Magnus Metal Div., National Lead Co., New York
Brake equipment	Westinghouse Air Brake Co., Wilmerding, Pa.
Driver and trailer-truck brakes	American Brake Company, St. Louis, Mo.
Cylinder protecting valves; cylinder cocks	The Prime Manufacturing Co., Milwaukee, Wis.
Piston heads and piston rods	Standard Steel Works Co., Burnham, Pa.
Piston-rod and valve-stem packing	U. S. Metallic Packing Co., Philadelphia, Pa.
Piston-packing and steam-chest valve-packing rings	Koppers Company, American Hammered Piston Ring Div., Baltimore, Md.
Cut-off and speed recorder	Valve Pilot Corporation, New York
Reverse gear	American Locomotive Co., New York
Crossheads	Standard Steel Works Co., Burnham, Pa.
Firebox steel	Bethlehem Steel Co., Bethlehem, Pa.
Boiler steel	Bethlehem Steel Co., Bethlehem, Pa. Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Boiler tubes	Pittsburgh Steel Co., Pittsburgh, Pa.
Boiler flues; steel pipe and mechanical tubing	National Tube Co., Pittsburgh, Pa.
Flexible staybolts and sleeves	American Locomotive Co., New York Flannery Bolt Co., Bridgeville, Pa.
Staybolt iron	(6) Ewald Iron Co., Louisville, Ky. (6) Ulster Iron Works, Dover, N. J.
Rivets	The Champion Rivet Co., Cleveland, Ohio
Engine-bolt steel; hexagon nuts	Milton Mfg. Co., Milton, Pa.
Slotted nuts	Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Firebrick	American Arch Co., Inc., New York
Boiler and cylinder lagging	(6) The Philip Carey Co., Cincinnati, Ohio (6) Johns-Manville Sales Corp., New York
Superheater; Tangential steam dryer	The Superheater Company, New York
Thermic syphons	Locomotive Firebox Co., Chicago
Washout plugs; syphon plugs	Huron Mfg. Co., Detroit, Mich.
Smokebox hinges; feedwater strainer; blow-off cocks	Viloco Railway Equipment Co., Chicago
Blower valves; drain cocks; blow-off cocks	The Okadee Company, Chicago
Smokebox blower fittings	Barco Manufacturing Co., Chicago
Pipe unions (Corley)	American Radiator & Standard Sanitary Corp., New York
Pipe insulation:	
Main high-pressure superheater steam pipes	Johns-Manville Sales Corp., New York
All steam pipes not under jacket	Union Asbestos & Rubber Co., Chicago
Feedwater heater	Worthington Pump and Machinery Corp., Harrison, N. J.
Feedwater heater throttle	The Lunkenheimer Co., Cincinnati, Ohio
Injector	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Boiler check for injectors and feedwater heater; coal sprinkler	Nathan Manufacturing Co., New York
Blower-pipe elbow	Barco Manufacturing Co., Chicago
Stoker	Standard Stoker Co., Inc., New York
Grates	Hulson Grate Co., Keokuk, Iowa
Spark arrester	Locomotive Firebox Co., Chicago
Cab apron; steel running boards	Alan Wood Steel Co., Conshohocken, Pa.
Cab side window sash	Aluminum Co. of America, Pittsburgh, Pa.
Clear vision windows; cab side windshields	The Prime Manufacturing Co., Milwaukee, Wis.

Hennessy lubricators are installed in the trailing-truck journal boxes—The pump-operating levers are shown against the end of the axle

Cab window glass	American Window Glass Co., Pittsburgh, Pa.
Throttle	American Throttle Co., New York
Safety valves	Ashton Valve Co., Boston, Mass.
Water gages	Hanlon Gauge Glass Co., Winchester, Mass.
Air and steam gages	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Gage cocks; water column	Nathan Manufacturing Co., New York
Miscellaneous cocks and valves:	
For saturated steam	Ohio Injector Co., Wadsworth, Ohio
For superheated steam	Walworth Company, New York
Low-water alarm	Barco Manufacturing Co., Chicago
Whistle	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Whistle operating valve	Viloco Railway Equipment Co., Chicago
Bell ringer	U. S. Metallic Packing Co., Philadelphia, Pa.
Rail washer	Nathan Manufacturing Co., New York
Sander valves and traps	T-Z Railway Equipment Co., Chicago
Lubricators, journal (drivers and trailer truck)	Hennessy Lubricator Co., New York
Mechanical lubricators (for cylinders, main valves, and chassis)	(6) Nathan Manufacturing Co., New York (6) Detroit Lubricator Co., Detroit, Mich.
Air-pump lubricator	Nathan Manufacturing Co., New York
Tire flange oiler	Detroit Lubricator Co., Detroit, Mich.
Oils and greases (initial lubrication)	Standard Oil Co. of New Jersey, New York
Grease fittings	Alemite Div. Stewart-Warner Corp., Chicago
Classification lamps	The Adams & Westlake Co., Elkhart, Ind.
Headlight; headlight generator; electric fittings; cab lamps	Pyle-National Co., Chicago

(*Continued on page 55*)

Field for High-Tensile

Steels in Freight Cars*

By A. F. Stuebing†

Five years of experience with freight cars built of high-tensile steels indicate how these materials should be used for maximum economy

In 1934, at a time when the railroads and car builders were eagerly searching for means of building more efficient freight equipment, the steel industry introduced low-cost steels having superior physical properties and greatly improved resistance to atmospheric corrosion. These materials, now usually designated as low-alloy high-tensile steels, were hailed as marking the advent of a new era that would be characterized by lightweight construction.

Five years have now elapsed since the first substantial numbers of freight cars built of high-tensile steels were placed in service. During that period the volume of production has increased and prices for the high-tensile steels, and for lightweight cars constructed of them, have been reduced considerably. It seems appropriate at this time to analyze the results obtained with the object of determining what influence these materials are likely to have on future development of railroad equipment.

Trends in Net Tons and Dead Weight

Before the low-alloy high-tensile steels were introduced, there had been a general trend toward freight cars of high capacity, primarily because the larger cars gave a more favorable ratio of pay load to dead weight and reduced costs due to the lesser number of units required. But in spite of the increase in car capacity, the tons per loaded car decreased. The best record in recent years was 27.1 tons in 1937, compared to 29.6 tons in 1920, although the average freight-car capacity increased from 42.4 tons in 1920 to 49.2 tons in 1937. The ratio of dead weight to load rose markedly from 104.40 per cent in 1920 to 138.94 per cent in 1937, and 149.67 per cent in 1938 as shown in Fig. 1. On some railroads, the ton-miles of dead weight in freight cars is now about three times the ton-miles of revenue and non-revenue load.

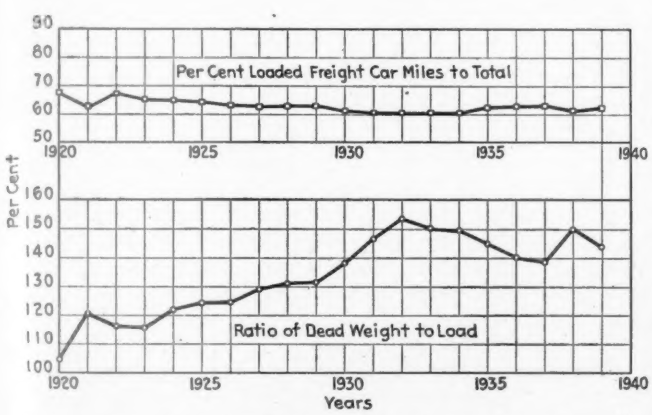


Fig. 1—Ratio of dead weight to load and percentage of loaded to total freight-car miles

It is interesting to observe how this trend has been reflected in the train load. The average freight train in 1920 carried 708 net tons of revenue and non-revenue load behind the tender; the cars, without lading, weighed 735 tons. In 1929, the average train load had increased to 804 net tons, or 13 per cent, but the weight of the cars had gone up to 1,061 tons or 44 per cent. In 1939, net tons per train attained a new high average of 813 tons. This was only 9 tons above 1929; but the weight of cars was 1,171 tons, or 110 tons more than in 1929. The variations in net tons and dead weight and the trends of each are shown in Fig. 2.

The installation of larger locomotives has enabled the railroads to haul substantially heavier freight trains, but the increase has occurred mostly in dead weight, not in revenue-paying tonnage. The average freight train in 1920 weighed 1,443 tons and earned $6.86 per mile. In 1939, the weight had increased to 1,984 tons but the revenue per mile had risen only 32 cents, to $7.18. This indicates that much of the gain in locomotive capacity has been offset by increases in the ratio of dead weight to pay load.

Cost of Hauling Dead Weight

In the early discussions of lightweight freight cars, the cost of hauling dead weight was recognized as a factor vitally affecting the profitability of freight service. The economies to be expected from weight reduction under various conditions were pointed out by such authorities as Ralph Budd, Joseph B. Eastman, K. F. Nystrom, and the Mechanical Advisory Committee to the Federal Co-ordinator of Transportation. These analyses generally accepted the principle that the savings in transportation expenses would be the proportion of each account affected which varied with the traffic, measured by the change in ton-miles, car-miles, or train-miles, according to which of these governed the individual account. Definite evaluations of savings were made on that basis and were in some cases applied by individual railroads.

Proceeding on the basis that savings in the cost of

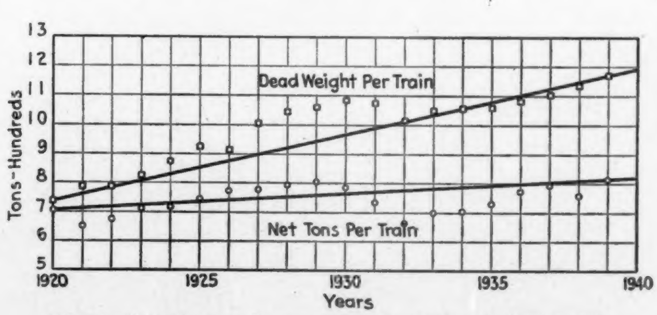


Fig. 2—Variations and trends in net tons and dead weight

* Paper presented before the November 21, 1940 meeting of the Railway Club of Pittsburgh.
† Development engineer, Carnegie-Illinois Steel Corporation.

transportation were of primary importance, the early high-tensile-steel cars were characterized by substantial weight reduction, compared with conventional cars. The cost of cars constructed of high-tensile steels was at that time generally $200 to $300 above the price for corresponding cars of copper steel. These additional expenditures were believed to be amply justified by the savings in operating costs that would result throughout the life of the equipment.

Experience with high-tensile steels in freight-car service has now been sufficiently extensive to enable any railroad to determine with reasonable accuracy how the use of various alternative applications of these materials will affect expenses and earning. At present, there is little uniformity of practice in the application of low-alloy high-tensile steels. Some cars are still being built with substantial weight reduction, but there is apparently a tendency toward compromise designs in which weight reduction is relatively small, the object presumably being to effect savings in car maintenance costs by the use of these superior materials.

The unit prices for high-tensile steels are now approximately one-fourth less than when these materials were introduced. The differential above the price of copper steel is about 50 per cent instead of 100 per cent. Under these circumstances, will it be more economical to use high-tensile steels with no change in thickness to reduce maintenance cost, rather than to decrease weight and improve the load ratio for the purpose of cutting transportation expenses? It will be worth while to analyze the factors involved in various alternative applications of corrosion-resisting high-tensile steels and to see to what extent the ultimate effect on the balance sheet can be determined at the present status of this development.

Effect of High-Tensile Steels on Costs

When any new type of material or construction is considered, one of the first questions raised is the effect on initial cost. In the case of freight cars, the total investment is large and fixed charges require careful consideration. The effect of the use of high-tensile steels on the initial cost of cars depends on the degree of weight reduction. Many applications of high-tensile steels do not increase the first cost. Box cars of these materials are available at prices no higher than conventional cars. High-tensile-steel hopper cars usually cost somewhat more per car, but frequently less per ton of capacity. One exception to these statements must be made in the case of cars with empty-and-load brakes, but less than one-sixth of all lightweight cars are so equipped.

By using low-alloy high-tensile steels, designers have an opportunity to reduce the cost of maintaining the bodies of freight cars, whether repairs result from mechanical damage or corrosion. Even when substantial reductions are made in the weight of the structure, cars of high-tensile steel, properly designed, have strength equal to or greater than cars of conventional heavy construction, and, in addition, these cars have superior resistance to corrosion.*

Fixed charges and maintenance costs are direct expenses and obviously are entirely chargeable to cars. The third important item, the cost of moving the car, is grouped with other expenses in the transportation accounts. Differences of opinion regarding the amount of transportation expense that can be saved by reducing the dead weight of freight cars are due to the complexity of the problem of determining to what extent these expenses will vary with a variation in car weight. However, logical methods of analysis have been developed by which the question of the amount that can be saved may be decided on the basis of facts instead of opinions.

The importance of considering operating savings in comparison with fixed charges and maintenance, is readily demonstrated. The average cost of freight cars at this time is about $2,700. Fixed charges on this sum at 8 per cent amount to $216 annually. Expenditures for repairs vary substantially from year to year. In 1938, they were $77.75 per freight car and, in 1937, $111.67.

Dividing expenses of conducting transportation, related solely to and apportioned to freight service by the average number of cars on line, we find that the cost of hauling each car and its contents was $520 in 1938 and $584 in 1937, exclusive of locomotive and track maintenance. Hauling costs in 1937 absorbed 5.7 times and, in 1938, 7.4 times the amount that was spent for car repairs and, based on the assumed price and rate, 2.4 to 2.7 times as much as fixed charges on new cars.

This comparison of expenses is over simplified. However, it brings out the fact that the largest opportunities for savings by the use of high-tensile steel in freight cars will almost certainly be found in operating costs rather than in maintenance. More thorough studies confirm this deduction and show that potential operating savings from lightweight high-tensile-steel cars are ample to absorb fixed charges on the slight additional cost and leave a substantial profit. Some economies may be effected by applying high-tensile steels to increase the period between repairs or replacements, but under normal operating conditions the largest gains are to be expected by using these materials in equipment which takes full advantage of the possibilities of weight reduction without sacrificing strength.

High-tensile-steel freight cars afford opportunities for operating and maintenance savings without any substantial increase in capital investment. Hence, they are now not an item of extra expense but a means of effecting extra savings. What the railroads need in freight-car material is strength and serviceability. At present prices, corrosion-resisting high-tensile steels cost less per unit of strength and per unit of life than copper steel which was previously the most economical material for such applications. The idea that weight and thickness are criterions of strength and serviceability will be abandoned by anyone who carefully compares the performance of high-tensile-steel cars with that of conventional equipment. Mere bulk is not essential to produce the strength required in cars unless the design is so crude as to be obsolete according to present-day standards.

The facts now available enable any railroad to determine with reasonable accuracy the relative costs for conventional freight cars and for high-tensile steel equipment. If such studies are made when new cars are being considered, applications that are of doubtful value can readily be avoided. However, on the basis of analyses that have already been made, it appears that lightweight high-tensile steel construction will be found more economical than conventional designs for a majority of all freight cars.

Discussion

C. O. Dambach, superintendent, Pittsburgh and West Virginia, referred to the statement that hopper cars of high-tensile steel usually cost more per car but frequently less per ton of capacity. What effect, he asked, does the method of loading have on the calculations? In reply, Mr. Stuebing said that his statement was based on the present method of rating car capacity, namely, the maximum permissible weight on the rail minus the light weight of the car. The reduction in the weight of the

* See report of Comparative Impact Tests of Pullman lightweight box car of 1937 and A. A. R. standard box car of 1932, and also article entitled Service Life of Cor-Ten Steel in Hopper Cars, page 847, December 2, 1939, Railway Age.

car results in a corresponding increase in the load that the car can carry. Therefore, if the increase in the cost of the car is less than the increase in the weight that can be carried, both on a percentage basis, the cost per ton of capacity of the car built of high-tensile steel would be less than the cost of a conventional car.

Karl Berg, superintendent motive power, Pittsburgh and Lake Erie, inquired if high-tensile steel is intended specifically for application to the car body or to the trucks and other parts as well. Mr. Stuebing replied that low-alloy high-tensile steels are primarily structural steels for use in the car body and are not intended to be forging steels.

Prof. Louis E. Endsley, consulting engineer, Pittsburgh, Pa., called attention to a paper on lightweight railroad equipment which he had presented earlier in the year. In this paper he had quoted figures to show that a reduction of 10,000 lb. in the weight of a freight car could be made by the use of this new steel. He had also quoted figures to show the cost of hauling dead weight in a freight car. Even the lowest of these figures, $12.00 per ton per year, would show an operating savings of $60.00 per car per year, if the light weight could be reduced five tons.

F. I. Snyder, vice-president and general manager, Bessemer & Lake Erie, reviewed the experience on his road with cars of lightweight construction. In the last five years, he said, nearly 70 per cent of the freight cars on the Bessemer have been built new and of these 6,200 are lightweight, open-top cars constructed of USS Cor-Ten steel. The 90-ton hopper cars of high-tensile steel show a savings of 10,000 lb. in the light weight as compared with the standard design for a hopper car of conventional steel built in 1931. This means that an additional five tons of revenue load can be hauled per car without an increase in gross load or cost. The same is true of the 70-ton cars which are built of low-alloy, high-tensile steel. In handling coal, the gain in revenue load for the cars of larger capacity without any increase in the rail load is 7,000 lb. The saving is less than for ore because cubical capacity and not axle capacity governs the loading of coal.

"We have not had much experience in the maintenance of these lightweight cars," Mr. Snyder continued, "because the average length of service of these cars over this five-year period is obviously two to three years, as the cars were purchased in six different lots. The tests which have been made of USS Cor-Ten steel have been very extensive and show qualities of durability which point to a decrease in maintenance costs. However, in our experience, the saving in transportation costs is so large that maintenance costs become of secondary importance. The value of the new cars will be enhanced by the economy anticipatd in maintenance. The effect of the new cars on car mileage is shown by a comparison of car operation in 1939 compared with the five years previous to the USS Cor-Ten open-type cars. There was a saving of 15 per cent in the car mileage, part of which is due to the increased nominal capacity of the new car but a large percentage is also due to the light weight of the car. There was an article in the Railway Age about two months ago on the operation of lightweight cars of large capacity and any one interested will find a lot of information in this article."

A. Stucki, president, A. Stucki Company, Pittsburgh, Pa., asked if this high-tensile steel had been used in the construction of boilers. In answer, Mr. Stuebing said that the low-alloy high-tensile steels had not been applied to boilers as they do not seem to be particularly adapted to that purpose. Up to this time it has not appeared that the requirements for boiler steel would be met better by the low-alloy high-tensile steel.

Western Maryland 4-6-6-4 Type Locomotives

(Continued from page 52)

Car replacers	American Chain & Cable Co., Inc., Bridgeport, Conn.
Metallic connections between engine and tender; joints in locomotive piping between articulated units	Barco Manufacturing Co., Chicago
Paint	E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Tender:	
Frame; trucks	General Steel Castings Corp., Eddystone, Pa.
Springs	Crucible Steel Co. of America, New York
Wheels	Standard Steel Works Co., Burnham, Pa.
Axles	Bethlehem Steel Co., Bethlehem, Pa.
Journal boxes	Symington Gould Corp., Rochester, N. Y.
Journal lubricators	Hennessy Lubricator Co., New York
Truck side bearings	A. Stucki Co., Pittsburgh, Pa.
Coupler	American Steel Foundries, Chicago
Coupler centering device and uncoupling arrangement	Standard Railway Equipment Company, New York
Draft gear	W. H. Miner, Inc., Chicago
Clasp brake	American Steel Foundries, Chicago
Brake shoes	American Brake Shoe & Foundry Co., New York
Tank plates	Bethlehem Steel Co., Bethlehem, Pa. Carnegie-Illinois Steel Corp., Pittsburgh, Pa. Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Washout plugs	Huron Mfg. Co., Detroit, Mich.
Hose strainer	The Okadee Co., Chicago
Water-level indicator	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marker lamps	Pyle-National Co., Chicago

plate, valve-motion pins, trailer-truck center plate, and the radial buffer. The furnace bearers are lubricated from oil cups.

The Cab and Tender

The cabs are steel, riveted, and are lined throughout with wood. They are of the vestibule type and are entered by swinging side doors, also of steel. The sash are of extruded aluminum and all glass is shatterproof.

One of the features of the cab arrangement provided for the comfort of the crew is a ½-in. breather pipe which extends across the back head of the boiler and which is connected to the main-reservoir air line. This pipe feeds several lateral lines closed with ¼-in. globe valves, each of which ends with 3 ft. of ½-in. hose. This arrangement permits members of the crew to have an individual supply of fresh air when passing through tunnels.

The cab is particularly roomy and is conveniently arranged. Extension handles from the auxiliary valves are readily accessible and are labeled.

The superheated-steam turret is mounted outside the smokebox in front of the superheater header. From it steam is fed to the air pumps, the stoker, the blower, and the whistle. A manifold for air auxiliaries is in the cab.

The air-brake equipment is Westinghouse No. 8ET. There are two 8½-in. cross-compound air compressors which are mounted on the deck of the front engine unit. Brakes are applied on all engine and tender-truck wheels, except those of the front engine truck. The locomotives have Brewster sanders, delivering in front of all drivers and in back of the main drivers. A Nathan rail washer is manually controlled by the engineman, both in forward and backward motion.

The tender tanks are copper-bearing steel of riveted construction, built up on General Steel Castings water-bottom frames. The six-wheel trucks are of General Steel Castings swing-motion type and have standard bronze bearings. Hennessy journal lubricators are applied in the journal boxes. The trucks include Unit cylinder clasp brakes.

The engine and tender connections consist of the Unit safety drawbar and the Franklin Type E-2 radial buffer. Barco type 3-VX pipe connections are used between the engine and tender. Barco connections are also used between the engine units. The tender draft gear is Miner A22XB.

Fig. 1—Arrangement of equipment for standing tests at the Selkirk, N. Y., enginehouse of the New York Central

New York Central's

Standing Locomotive Tests*

Part I

By W. F. Collins †

Test method developed to control temperature and pressure of exhaust steam in study of front-end design—Effect of various changes in the front end on the boiler performance

Tests made by road or stationary dynamometer have been the means of studying the effect of changes made in the design of smokebox arrangements. These tests are costly and other means have been tried in their place; namely, the model tests and locomotive standing tests.

The locomotive standing tests offer one method for this study where uniformity of conditions can be maintained, the effect of minor changes can be observed, and the road performance predicted without incurring either the difficulties of procedure or the uncertainties in the results of road tests. This method of test offers simple and effective means for improving the design of smokebox arrangements and nozzles. It should be added that the standing tests are suitable not only for the study of smokebox problems but for other tests in which the performance of the boiler only is involved; such as the performance of feedwater heaters, fuel, stokers, etc.

Early Locomotive Standing Tests

Early locomotive standing tests were made by the New York Central at Gardenville, N. Y., enginehouse in 1923 by placing the locomotive in a fixed position, disconnecting the engine machinery and operating the boiler. The piston was removed and the gland opening was closed by suitable means, so that the cylinder served as an expansion chamber. The exhaust pressure was maintained constant by the regulation of a special gate valve installed above the steam chest. The exhaust pressure for any given smokebox arrangement determined the quantity of air moved. This air, in turn, determined the rate of combustion and the amount of steam generated. The steam generated by the boiler was passed, either wholly or in part, through the exhaust nozzle in the usual way.

It was recognized‡ that while these tests served admirably as a means for studying the effect of smokebox changes, the value of different nozzles, etc., they could not be used as a reliable indicator of actual nozzle area until considerable experience and judgment had been acquired. The reason for this statement is that the exhaust steam had a greater volume for a given exhaust pressure, owing to the high degree of superheat, which ranged from 300 to 450 deg. F. While the boiler pressure was reduced to a predetermined value equal to that of the exhaust pressure there was no reduction in temperature corresponding to the thermal heat drop in the cylinders when mechanical work is performed and transmitted to the drivers. The total enthalpy of the steam at boiler pressure was approximately the same for the exhaust steam and, therefore, the specific volume during

* Paper presented at the annual meeting of The Railway Fuel and Traveling Engineers' Association on October 23, 1940, at Chicago. This paper will be published in two parts.

† Engineer of tests, New York Central.

‡ See "Standing Tests of Locomotives Offer Practical and Simple Means for Studying Draft Appliances," 1930 Proceedings, International Railway Fuel Association.

the test was 50 per cent greater than that obtained during road operation. Consequently, the exhaust steam of the early standing tests had a higher velocity through the stack which resulted in moving a greater quantity of air than could be accomplished in road service with the same size nozzle. Conversely, a nozzle with a greater area, resulting in lower exhaust pressure, could be used during standing tests to move the same quantity of air as required for road service.

As the amount of gas expelled from the smokebox by the exhaust nozzle and stack combination depends on the energy in the steam rather than the weight, the results in some cases have been misleading and none were comparable with those obtained on road tests. A mention of this condition is made at length in order that results of the early standing tests may be properly appraised, and the conclusions developed from these results considered accordingly.

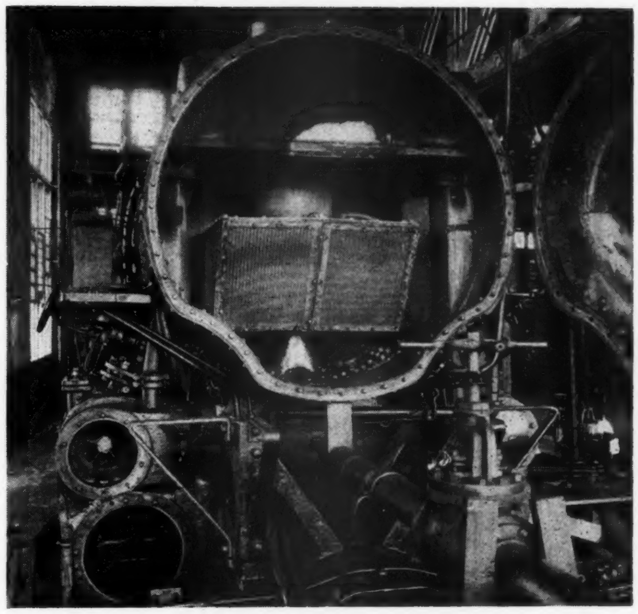


Fig. 3—The water sprays may be seen in the cylinder—The bleed-off control valve is in the foreground

Recent Locomotive Standing Tests

In view of the information given above, some time was spent by the author in studying the results obtained by these early standing tests. The conclusion reached was that a control of the temperature was also needed in the modern locomotive using superheated steam if the test results obtained on these standing tests were to approximate those obtained in road service. In other words, it was not only necessary to reduce the pressure, but also the temperature and the enthalpy so that thermal conditions, or the state of the exhaust steam during the standing tests, would be identical to the thermal conditions experienced in road tests.

The method for controlling the temperature of the exhaust steam during the standing test is through the medium of the spray of water mist in the cylinder which is subsequently removed in its entirety. The locomotive standing test with the exhaust temperature thus controlled produces a more accurate and economical method for study than heretofore. The performance of the locomotive boiler is considered to be entirely independent of the engines and subject to its own particular laws. It is the boiler rather than the engines which determines and limits the capacity of the locomotive.

Fig. 1 shows the general arrangement of a New York Central locomotive on a recent standing test at the Selkirk, N. Y., enginehouse. The method of testing a stationary locomotive boiler by special means and for controlling temperature and pressure of exhaust steam to the nozzle is shown in Fig. 2.

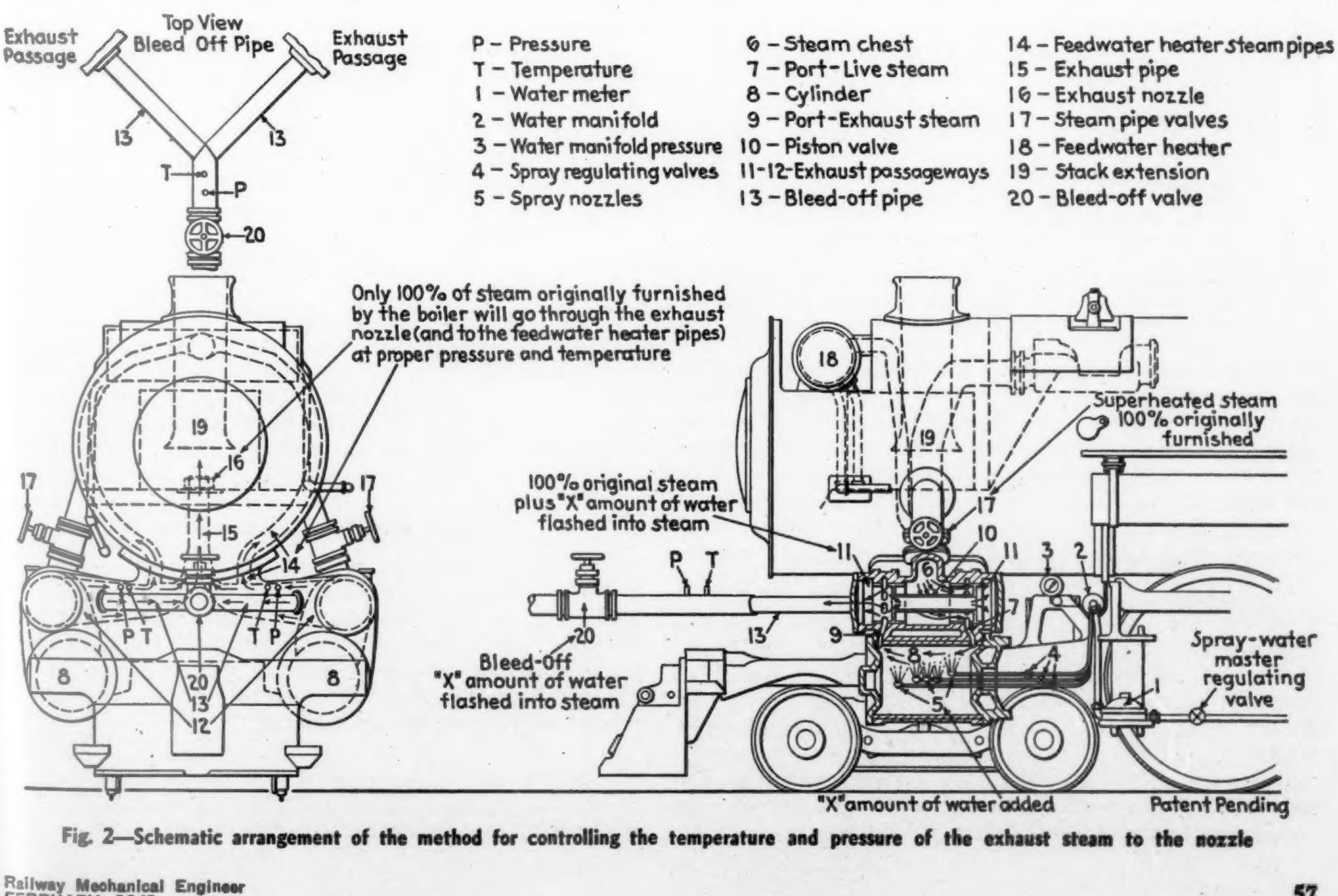


Fig. 2—Schematic arrangement of the method for controlling the temperature and pressure of the exhaust steam to the nozzle

The superheated steam, which may be designated as 100 per cent at the steam-pipe valve *17* is admitted to the valve chest *6* and from there passes through the valve bushing at the rear of the valve chest and into the cylinder where it encounters a series of sprays of water and is reduced in temperature or desuperheated. The controlled sprays add an *X* amount of water and the 100 per cent of steam plus this *X* amount, which has been flashed into steam from the water, passes from the cylinder through the valve bushing at the front end of the valve chest and into the exhaust passageways. From the exhaust passageways the steam divides, part passing through the nozzle *16* and part passing through the bleed-off valve *20* where an *X* amount of steam is extracted or bled off in order that only 100 per cent of the steam originally furnished by the boiler will go through the exhaust nozzle (and to feedwater-heater steam pipes *14*) at the proper pressure and temperature. Fig 3 shows the sprays *5* in the cylinders, the bleed-off valve *20,* and the steam-pipe pressure valve *17.*

Fig. 4 shows graphically the results from a road dynamometer test and a recent standing test for the same New York Central Class J-1 locomotive with identical arrangements of the smokebox, firebox and nozzle. It was noted that the apparatus and method of a standing test duplicate exactly the thermal conditions that take place when steam is used during road tests, or during stationary dynamometer tests where the main pistons are used to convert the energy of the steam into work at the drivers.

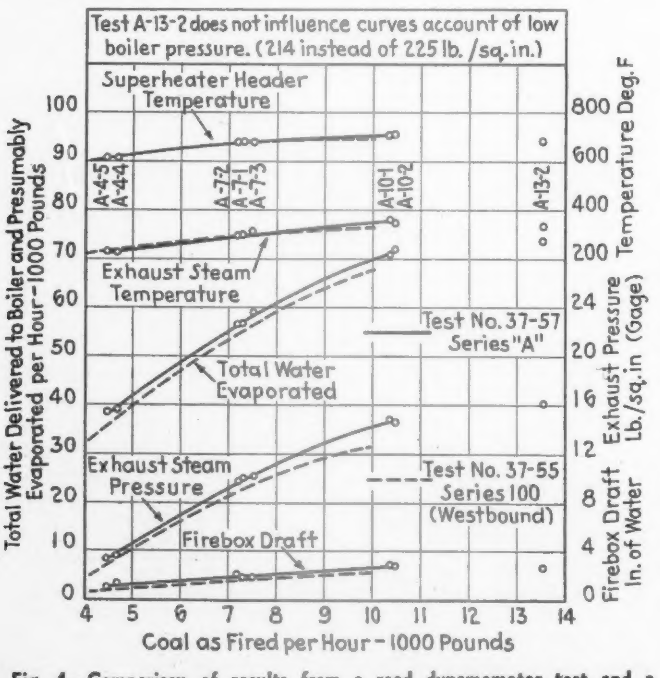


Fig. 4—Comparison of results from a road dynamometer test and a standing test for the N. Y. C. Class J-Ib locomotive No. 5224 with identical arrangements of firebox, smokebox and nozzle

Properties of the Exhaust Steam

The properties of the exhaust steam in road service show that the degree of superheat changes with the quantity of steam flowing through the nozzle and is related to the cut-off of the engines. The degree of superheat ranges from about 20 deg. F. at the steam rate of 30,000 lb. per hr. to about 90 deg. F. at a steam rate of about 80,000 lb. per hr. The exhaust pressures and temperatures used on the standing tests are obtained from the same class of locomotive selected for this purpose in road service under maximum operating conditions.

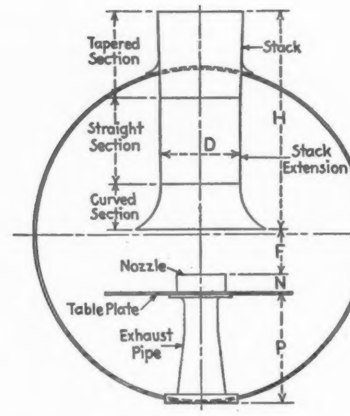


Fig. 5—Designation of lettered dimensions in the front end

The exhaust nozzle and stack present many problems for research and with better knowledge of them it may prove possible to furnish the air for combustion at appreciably less exhaust pressure.

Results from Recent Standing Tests

A mention of the recent locomotive standing test results obtained in connection with the New York Central's investigation of the smokebox arrangement was made before this association by M. S. Riegel, assistant engineer of tests, New York Central, at the November, 1938, meeting.

The results to be presented here were obtained from tests conducted on the plant described above and, in each case, identical test conditions prevailed for each series of tests so that the results would be comparable. These results concern particularly the tests of a smokebox arrangement for a modern coal-burning steam locomotive whose pertinent boiler characteristics* will be given in the graphs showing the rate of evaporation.

The tests of the J-1 locomotive covering the *ZM* series (improved smokebox arrangement) and the *A* series (standard smokebox arrangement) were conducted with the same size of exhaust nozzle (7⅜ in. diameter) and the same size and type of basket bridge. The results obtained for the two series are directly comparable. The results of the *ZM* series and those of the *B* series (standard smokebox arrangement 6¾-in. nozzle) are not directly comparable because of the difference in exhaust-nozzle diameter. However, a comparison is made herein since the Class J-1 locomotives in road service have been equipped with the standard smokebox arrangement and 6¾-in. nozzle.

Some of the preliminary results of the Class J-3 locomotives will also be shown—The *JB* and *JR* test series covering nozzle tests, and a comparison of the evaporation rates of the *JR* series (improved smokebox arrangement) equipped with 7-in. divergent nozzle and the *AA* series (standard smokebox arrangement) equipped with 6¾-in. nozzle. All of these series use the ½-in. basket bridge.

Stack and Stack Extension

The effect of changing the diameter of the stack was investigated (see *D* in Fig. 5) and it was found that by increasing the diameter the performance and capacity of the boiler was increased. The limit of the stack diameter being governed by the velocity of the discharge of the gases and steam from the outlet of the stack which is related directly to smoke trailing.

* Additional boiler data enumerated in C. A. Brandt's paper, "The Locomotive Boiler" presented before the Railroad Division, American Society of Mechanical Engineers, on December 4, 1939, at Philadelphia, Pa. An abstract of this paper appeared in the February and March, 1940, issues of the *Railway Mechanical Engineer.*

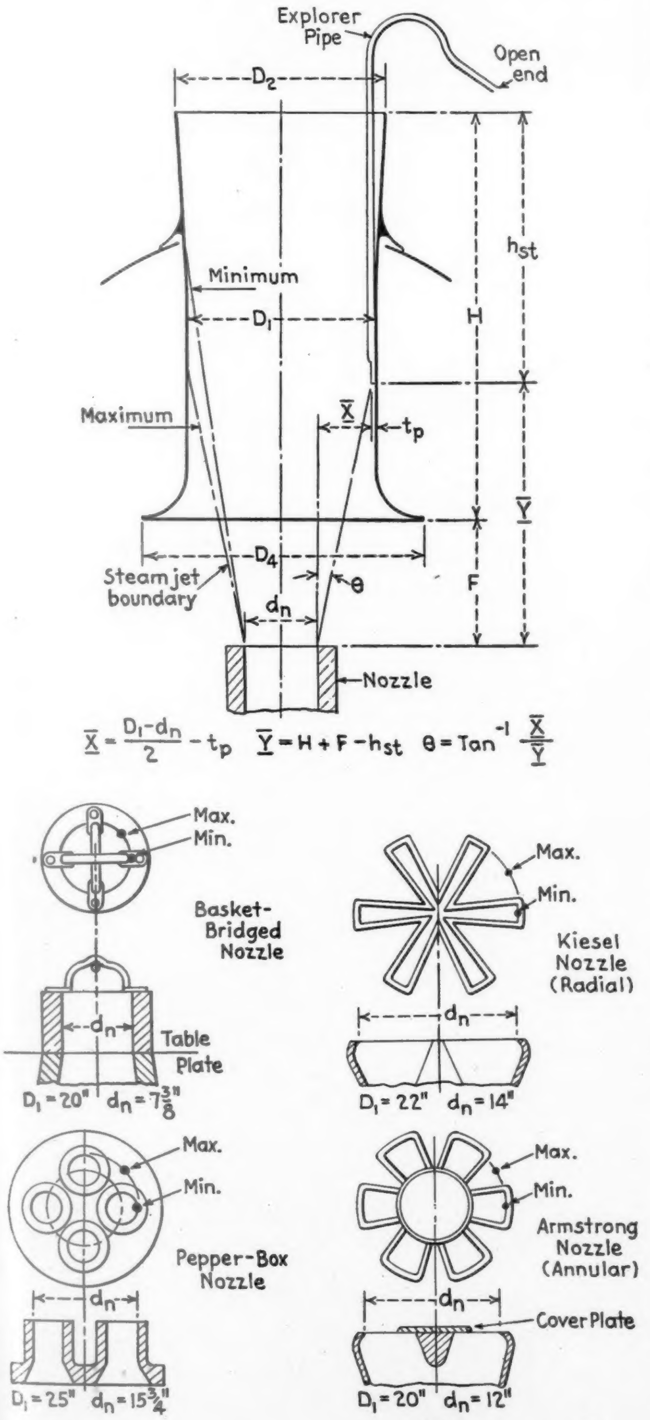
The contour of the stack extension was studied and it was determined that a liberal radius is desirable but increases in the length of the radius had no appreciable effect upon the performance of the boiler. It was found that the straight portion of the stack extension had a definite relation to the type and kind of nozzle used. In general, it was found that a straight length of the stack of about 1½ diameters gave the best performance of the boiler and if less than this ratio was used the performance was found to be slightly impaired in each instance. The length of the straight section of the stack governs the total or over-all length of the stack and stack extension.

The effect of changing the diverging taper of the stack was investigated to a limited extent. It was found that the usual two-inch taper per foot of length of stack was satisfactory, although a taper of only one inch per foot of length was used without any appreciable detrimental effect upon the performance of the boiler. The performance of a stack with straight sides did not equal the performance of the tapered stack, except when special nozzles were used. With special nozzles, the straight stack did not exceed the performance of the boiler with tapered stack and circular nozzle with basket bridge for stacks of equal choke diameters.

The effect of changing the distance from the table plate to the lower edge of the stack extension (*N* plus *F* in Fig. 5) by varying the length of the stack was studied in connection with the basket bridge nozzle and it was found that below 8 in. and above 24 in. the boiler performance was adversely affected. Between these limits the performance of the boiler was not appreciably affected but the best performance was obtained with a dimension of 16 in. The reason for the poor performance below 8 in. was due to the restriction of the stack to the gases, as reflected by the gas analysis. Above 24 in., the operation of the arrangement was unstable at the high rates of evaporation due to the impingement of the steam jet against the radius of the stack extension.

A study was made of the effect of changing the distance from the exit end of the exhaust nozzle to the lower edge of the stack extension (*F* shown in Fig. 5) by varying the length of the nozzle while the distance between the table plate and the stack remained constant. This latter measurement was 16 in.

For an *F* dimension ranging from 12 to 2 in., the performance of the boiler was not appreciably affected and the best performance was found to be at 10 in. At less than 2 in. below the edge of the stack and 6 in. above the edge of the stack, where the nozzle penetrated into the stack, the boiler performance was unstable and the higher rates of evaporation could not be obtained. The steam impingement of the jet upon the stack could not be obtained with the exploring tube and evidently the jet did not contact the upper portion of the stack.



Nozzle	Coefficient of discharge at 65,000 lb. of steam per hr. through nozzle	Angle of jet contact with stack, deg. Max.	Min.
Basket bridge	0.91	16	7½
Pepper-Box	0.93	6	4
Kiesel (radial)	0.90	6	3½
Armstrong (annular)	0.91	8	4½

Fig. 6—Method of determining the angle of jet contact with the stack—The jet angle and coefficient of discharge for various nozzles

Impingement of Steam Jet upon the Stack

The impingement of the steam jet upon the stack was investigated for stacks with diameters of 18, 19, 20, 22, 25 and 26 in. The angle of the steam jet leaving the nozzle was calculated from this data.

In general, no nozzle tested gave a single jet angle, as the jet angle changed from a minimum to a maximum for each type of nozzle tested. Fig. 6 shows the equipment and method of determining the angle of jet contact with the stack, together with information showing the jet angle obtained and the coefficient of discharge for the different nozzles shown. The jet angle varies slightly with the rate of steam discharged through the nozzle at different exhaust pressures. In the design of a smokebox arrangement, it is evident that the particular nozzle under consideration or test should be given special consideration in relation to the stack selected.

The basket bridge used with the circular nozzle was made from a rod ½ in. in diameter. When a ¾-in. diameter bridge was used a greater angle was obtained and a lower impingement was noted on the stack. A special ½-in. bridge was developed which resulted in a smaller angle and a higher impingement on the stack.

(To be concluded)

New box cars on the delivery track outside Havelock shops

C. B. & Q. Builds

A Thousand Box Cars

Fifty-ton steel-sheathed cars, built at Havelock, Neb., follow A. A. R. design — Fifty are equipped for head-end passenger-train service

WITH heavy motive-power repairs largely concentrated at shops in West Burlington, Ia., and Denver, Colo., the Chicago, Burlington & Quincy removed much of the machinery from its Havelock, Neb., locomotive shop

The ceiling and end lining are Douglas fir plywood

a few years ago and made such revisions of shop equipment as were necessary to adapt this shop to freight-car rebuilding and new construction programs. With excellent heat, light and crane facilities, the limitation of a relatively short shop (about 600 ft.) has been overcome by moving cars from one position to the next down one track in the erecting shop and back another, so that 24 cars in various stages of construction can be accommodated in the main shop building. Necessary sandblasting and cement-spraying operations are performed outside and painting in a well-equipped paint shop built in part of the old boiler-shop building. With detail construction and assembly operations organized on a production basis, this shop is well adapted to show excellent results in turning out either new or rebuilt cars.

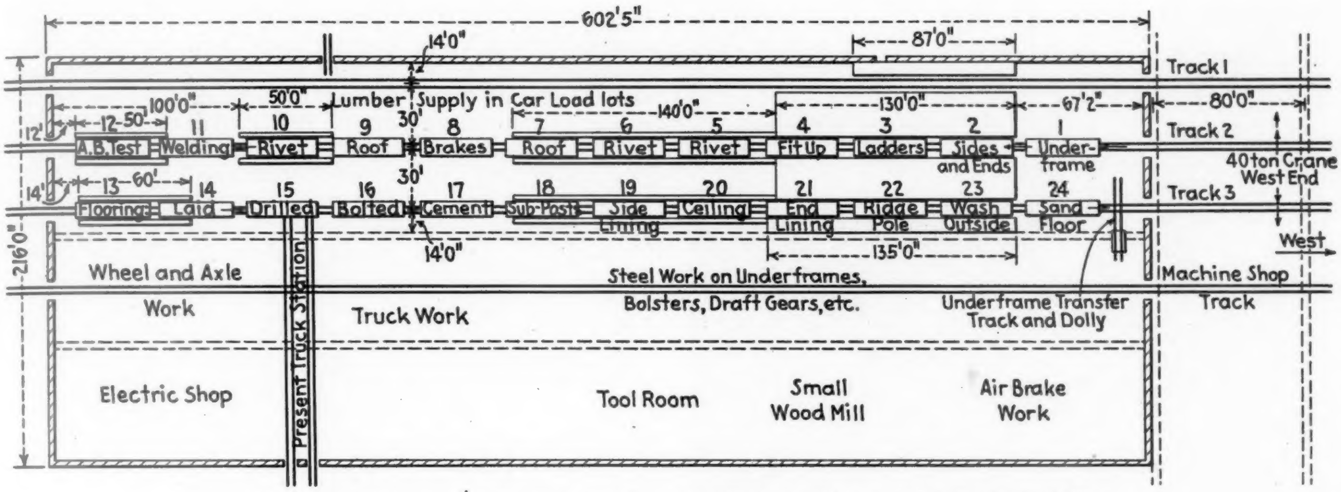
At the present time, for example, a series of 1,000 modern 50-ton steel-sheathed box cars is being constructed at Havelock shops and, with the production line timed for a move every 38 minutes, the output is 12 cars one day and 13 cars the next, with a total force of 219 men, including 110 mechanics, 87 helpers, 8 laborers, 14 welders and painters. Some idea of the workmanship built into these cars is given by the leading illustration, which shows a group of cars just out of shop. The cars are stencilled Burlington Route, Way of the Zephyrs on one side and Everywhere West on the other. Recognizing the probability of unexpected delays at various points in the car assembly line, a limited number of materials and parts have been provided at strategic points in advance so that they can be injected into the production line and enable the daily output mentioned to be maintained with notable regularity.

General Dimensions of New Burlington 50-Ton Box Cars

Inside length, ft.-in.	40- 6
Length over end sills, ft.-in.	40- 8¼
Length over striking plates, ft.-in.	41- 8½
Width inside, ft.-in.	9- 2 1/16
Width over side sills, ft.-in.	9- 9⅝
Width of door opening, ft.-in.	6- 0
Width over all, not to exceed, ft.-in.	10- 8
Inside height, floor to ceiling eaves, ft.-in.	10- 6
Height, rail to floor top, ft.-in.	3- 7¾
Height, rail to top of running board, ft.-in.	15- ⅜
Height, rail to center of coupler, ft.-in.	2-10½
Height, rail to body center plate, ft.-in.	2- 1¾
Height, door opening in the clear, about, ft.-in.	9-11½
Truck centers, ft.-in.	30- 8½
Truck wheel base, ft.-in.	5- 6

Principal Features of the Cars

The 1,000 new Burlington 50-ton box cars, built essentially of open-hearth copper-bearing steel by a combina-



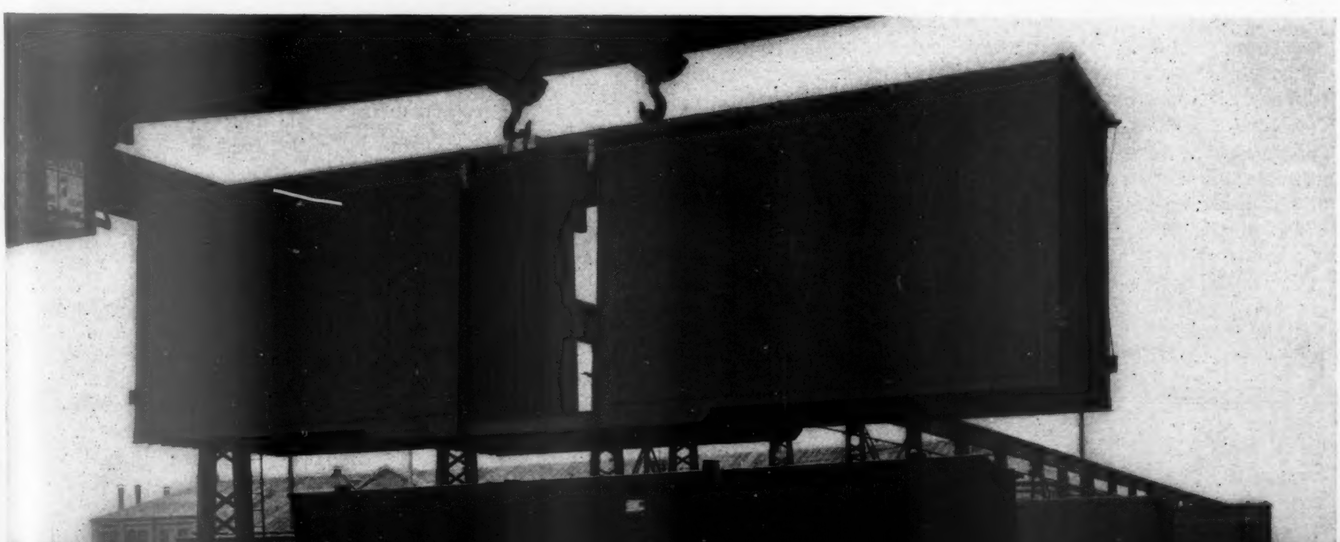
Line up of work on new 50-ton box cars at the Havelock, Neb., shops of the C. B. & Q.

Operations in Building New 50-Ton Box Cars at Havelock Shops

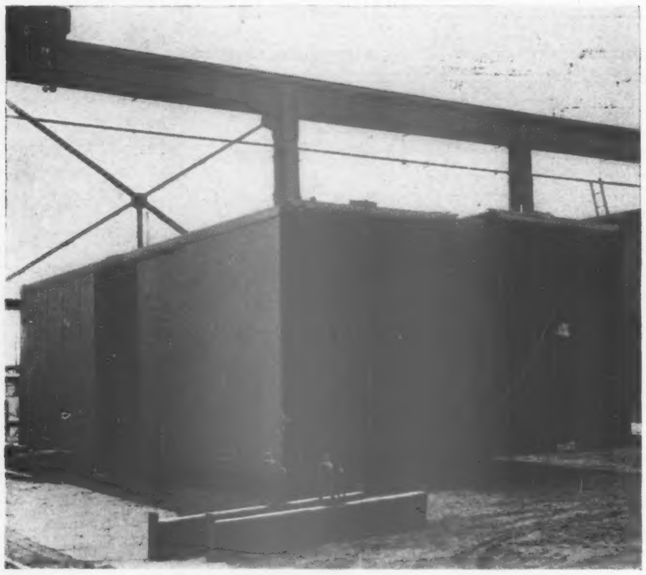
Station No.	Operation Performed
1	Assemble underframe on trucks; riveting, 50-ton Hanna riveters
2	Apply side sheets and ends
3	Apply side and end ladders; apply doors and door tracks
4	Fit up and rivet ends and top corner gussets; fabricate roof adjacent to No. 4 position
5	Riveting under center of car
6	Riveting sides, ends, underframe, etc.
7	Apply and ream roof and paint
8	Apply brake equipment
9	Apply scaffolds for roof riveters
10	Riveting roof
11	Miscellaneous welding such as corners
12	Air brake tests; sand blast and cement (outside of shop)
13	Floor fillers applied, flooring placed in car
14	Lay floor and door post fillers
15	Drill floor
16	Bolt floor
17	Cement around ends of floor
18	Sub posts for side lining applied
19	Side lining applied and nailed
20	Ceiling applied
21	End lining applied
22	Ridge pole purlins and headers applied
23	Wash car outside
24	Sand floor and inspect car
25	Paint, stencil and inspect (in paint shop)

Work done outside the assembly line:
Truck station; wheel plant; punch plates; bolsters and diaphragms; fit up and weld center sills; assemble and ream underframe; rivet underframe; apply draft gears; weld underframe; mill room; crane operators; cleaning cars and shop.

tion of both welding and riveting, are of the double-sheathed type with wood inside lining and conform in all essentials to Association of American Railroad standards, as regards size and standards specified for cars for interchange service. These particular cars have an inside length of 40 ft. 6 in.; width of 9 ft. 2 in., and height from



Method of unloading Youngstown steel sides at Havelock shops



Arrangement of tie rods to keep car sides together for unit-load handling—Two lifting cars are shown in foreground

floor to ceiling eaves of 10 ft. 6 in., which gives a cubic capacity of 3,898 cu. ft. The light weight of the car is 46,300 lb. and the load limit, 122,700 lb.

Minor changes from A. A. R. standard construction include, among other features: strengthening the side-sill reinforcement connection to the bolster diaphragms; improving the floor-beam connection to the side sills and the side-sill reinforcement to the outside of the door posts; stiffening the door posts; doubling the number of stringers between bolsters; providing ¼-in. Douglas fir plywood ceilings and ¾-in. plywood end lining, etc. A limited amount of high-tensile, low-alloy corrosion-resisting steel is used in such parts as bolster top cover plates, diagonal braces, stringers between crossbearers, center-sill separators, etc.

The first 100 of these cars are equipped with Allied Full-Cushion trucks. Fifty of these cars equipped with steam and air-signal lines, two-wear wrought-steel wheels and painted a dark Pullman green, were completed and placed in head-end passenger-train service in November, 1940, and gave an excellent account of themselves in the safe, smooth and fast handling of extensive express shipments on the Burlington during the year-end holiday season. Largely owing to special equipment used on the first 50 cars, the light weight of these cars is 49,900 lb.

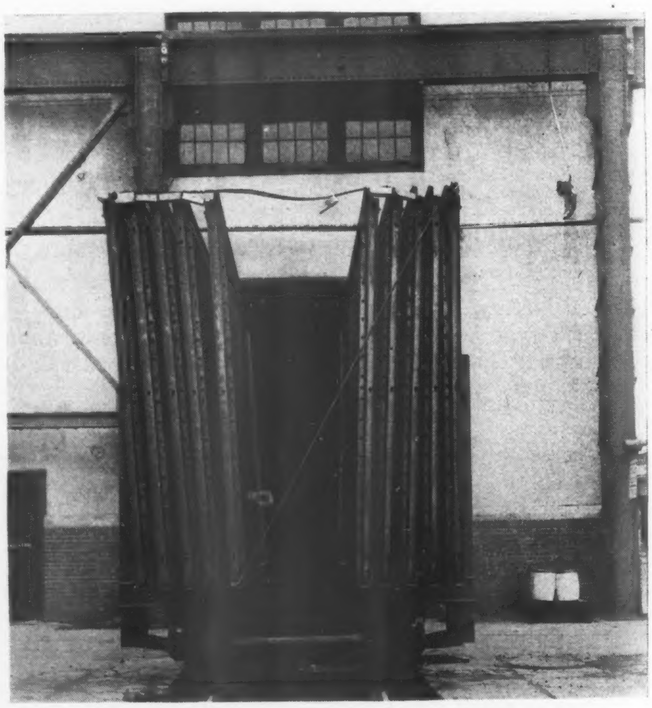
Underframe reaming device used at the Havelock car shop

All of the 1,000 new Burlington box cars are to be equipped with Youngstown all-steel sides, Dreadnaught two-piece steel ends, Murphy improved solid steel roofs, and Type AB brake equipment furnished by Westinghouse. A. A. R. approved freight-car draft gears of the following types are installed: Cardwell-Westinghouse, Edgewater, Miner, National, Peerless and Waugh. Both Camel and Creco-type single corrugated steel doors are used. Hand brakes are of the Ajax, Miner, or Universal "Non-Spin" types, designed to meet A. A. R. requirements. Royal slack adjusters are installed, either end- or side-operated.

Five different types of trucks are used, including Allied Full-Cushion trucks, Unit-type trucks, National Type-B trucks, Bettendorf and American Steel Foundries double-truss self-alining trucks. On all cars except the first fifty, 33-in. chilled-iron car wheels, weighing 750 lb. per wheel, are installed. Standard freight-car journal brasses and Cotton journal-box packing are used.

How the Cars Are Built

Reference to the drawing will show the general location of all important detail work as well as operations in



The car sides are moved into the shop on special dolly trucks

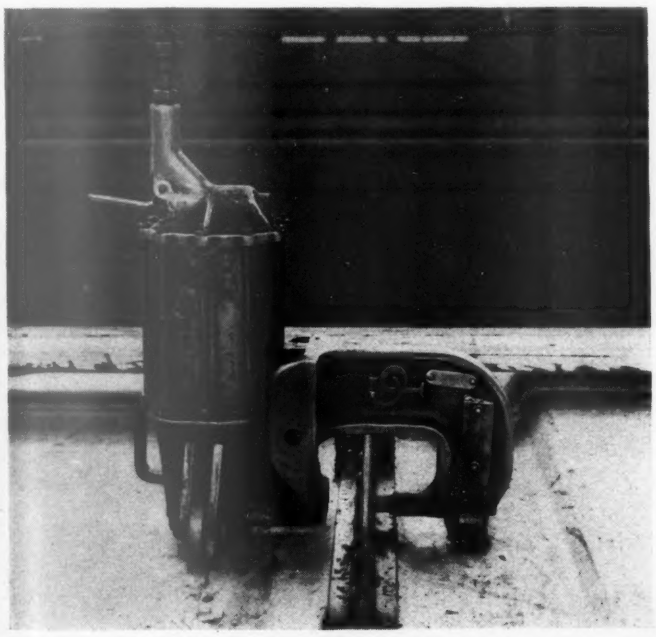
the assembly line at the Havelock car shops. Additional details regarding the work performed at each position are given in the table. Car assembly operations are performed in 24 positions on Tracks 2 and 3, all lumber moving to the assembly lines from Track 1 and all steel parts, such as wheels and axles, trucks, underframes, etc., coming from the machine shop. The east side of the shop is devoted to air brake work, a small mill room, tool room and electric repair shop, as shown in the drawing.

Underframe parts sheared and punched at the Galesburg, Ill., shops of the Burlington are shipped to Havelock and assembled by welding and riveting at the position shown in the drawing. When completed, these underframes are moved, one at a time, by the machine shop crane to the dolly and transfer track indicated at the north end of the shop, then being readily pushed into the erecting or assembly shop where it is picked up by

one of the two erecting cranes and mounted on its own trucks at position No. 1. Other operations at a total of 12 positions on Track 2 are performed as indicated on the drawing.

The entire line of coupled cars moves every 38 min., with suitable whistle warnings to enable all men to get clear. Electrically operated car pullers are located conveniently and one interesting feature is the provision of reverse pullers to drag the long heavy steel cable back into the shop by means of another small cable and thus avoid the necessity of having two or three men do this work by hand. The couplings between cars are sufficiently long to give adequate working room and, where single-plank platforms extend across scaffolds between the cars, these are counterbalanced so as to be easily swung up out of the way whenever the cars are being moved. One important feature of this shop is the provision of an adequate supply of working scaffolds of both the permanent and movable types, usually embodying welded tubular steel construction, which is both light and strong, and provided wherever feasible with safety guard rails.

From position No. 12, the cars move out of the shop at the south end on a track which has room for 12 cars and is equipped for sandblasting and priming the ends to assure a good paint job, also giving all underframe and inside steel superstructure parts a coating of protective car cement. It is necessary to hold about one day's output of cars on this track to give time for drying. During the sandblasting operation, the entire truck is protected with two sections of canvas, moved in, one from each side of the car. A switch engine is then used to switch these cars to Track 3, where they pass into the shop and through the various positions from No. 13 to No. 24, as shown on the drawing.



Chicago-Pneumatic roof riveting device equipped with rollers and sliding shoe for easy movement over car roofs

From Position 24 the cars move out of the car shop and are handled by a switcher to the paint shop where two coats of freight-car red synthetic enamel are applied, and the cars stencilled. The paint shop occupies about one-half of the old boiler shop and consists of two tracks under a low ceiling and side constructed of scrap car roof sheets. Three exhaust fans and one large ventilator fan are used to assure satisfactory ventilation and there are seven 10-in. heater pipes along one wall to maintain the proper temperature. In addition, experience having indicated that superior results are secured by not attempting to paint frosted steel surfaces, 50-ft. heating coils are installed at each of the first paint stations to assure rapid drying of the steel surfaces preparatory to painting. Another precaution to assure an exceptionally good paint job is washing down the car sides with mineral spirits at Position 23 in the car shop. The Youngstown steel car sides are, of course, given a priming coat before shipment.

Scaffolding arrangement at the riveting position—The rivets bins are scrap air reservoirs

In stencilling, paper stencils are applied to light metal and wood frames large enough to cover one-quarter of the car. The type of light, welded, steel scaffold and the fixed scaffold used in stencilling cars is clearly shown in one of the illustrations. Stencils are sprayed, a helper being employed to help handle the stencil and hold that part being used closely against the metal. Stencils are washed in mineral spirits twice a day, during the noon hour and at 5 p. m. Any necessary touch-up work is also done at the stencilling station.

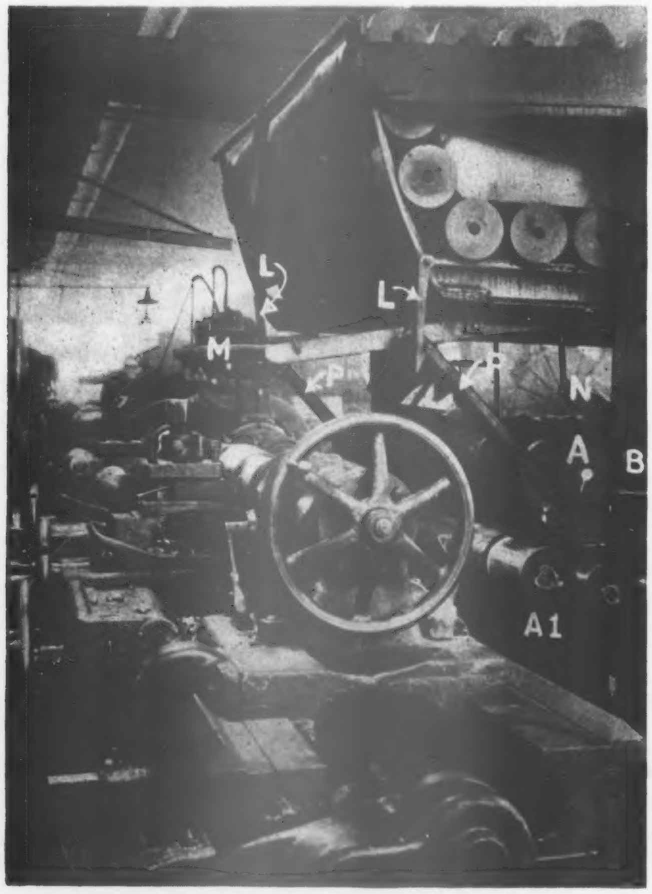
From the paint shop the cars are moved by car pullers

Jig used in applying battens to plywood ceiling panels

to the scales on an outside track for light weighing and completing the stencil. At this point the cars get final inspection and the application of commodity tags and door seals, ready for shipment.

What the Illustrations Show

One of the unique features of the present box-car construction program at Havelock shops is the way in which the Youngstown steel sides are handled from the car to storage in the shop yard under the gantry crane and thence to the shop where they are applied to the car underframe. One of the views shows 14 of these straight and smooth car sides being lifted as a unit from the gondola car by means of the gantry crane and two lifting bars, or equalizers, applied through the doorway, one being placed as near as possible to each door post.

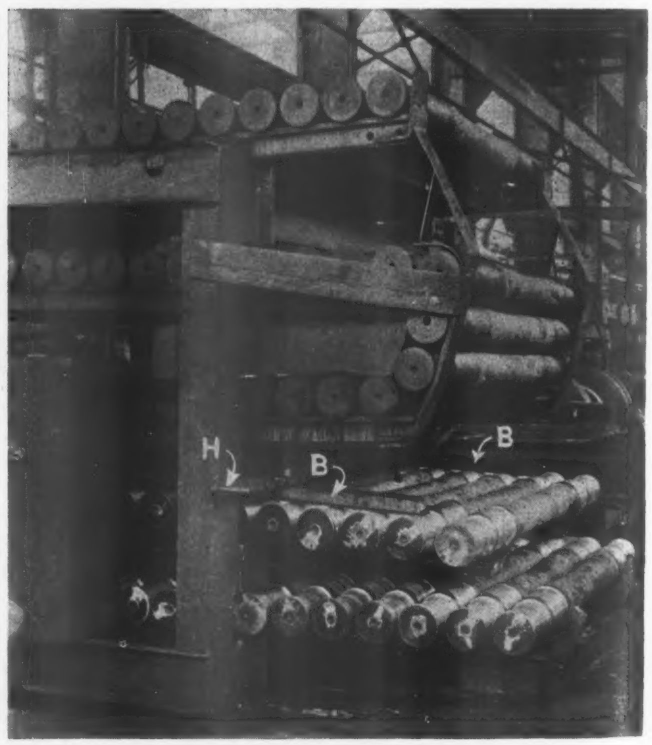


Axle lathe and special device used for automatically handling axles to and from the lathe

Before lifting the car sides, the diagonal tie rods at each end are disconnected from the gondola car and each fastened to one of the outside sheets by means of a small plate. This ties the entire load of car sides together and enables it to be handled as a unit instead of singly, which entails considerable extra time and expense. A close-up view of two loads of car sides in storage under the gantry crane is shown in a second illustration, which also gives a close-up view of the two lifting bars, made of 12-in. I-beams and equipped with a suitable clevice at the center of each for attachment to the crane hook and a stop plate welded to the I-beam at each end.

From storage the Youngstown steel sides are moved as a unit onto special dolly trucks shown in a third view, which consist of two car trucks equipped with 9-in. channels welded to the bolster side bearings and having vertical side channels of the same material welded to the bolster channels and braced at the bottom with short horizontal rods. On these dolly trucks, the car sides may be readily pushed into the shop, the end ties released and the sides handled one at a time by the shop crane with double hooks through door post holes to the desired position for application to the underframe. The use of a long, heavy and awkward walking beam is avoided by this method of handling the car sides.

Various other labor-saving devices are shown in the halftone illustrations. For example, on the underframe fabrication job, a very convenient tool is illustrated for reaming holes upward from the underside of the frame. This device consists of a Thor high-cycle electric motor mounted in a welded tubular frame, having two small wheels which provide easy portability and serve as a fulcrum to give the necessary upward pressure when the operator bears down on the handles. The handles are long enough to give a good leverage, the control switch is located on the right handle. The motor itself is not rigidly mounted in the frame but pivots on two bolts, one of which is shown, the point of suspension being slightly above the center of gravity so that the motor always keeps an approximately vertical position. The frame of this device is equipped with a small tubular container which forms a convenient receptacle for necessary reamers or drills.



Rear view of the axle device showing how axles may be loaded at the top level and delivered at the bottom after machining

For reaming horizontal holes through diaphragms and center sills an extension reamer with 4-ft. sockets is used to enable the operator to ream the hole while standing in a comfortable position just outside the car underframe and thus avoiding the necessity of crawling under it.

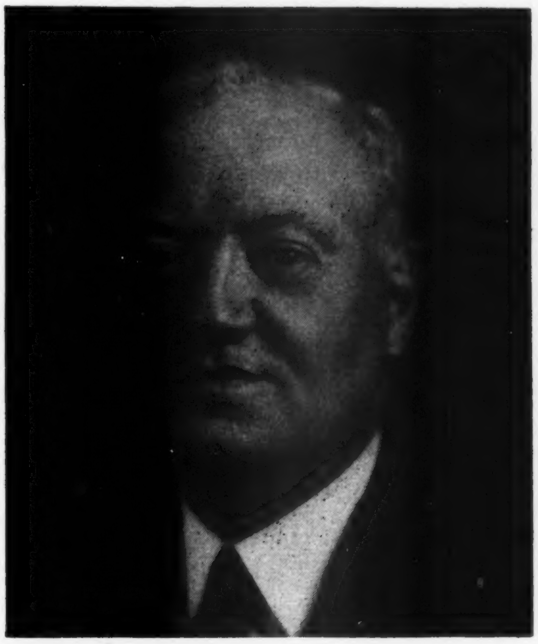
Another illustration shows a roof-riveting machine which consists of a Chicago Pneumatic squeeze riveter and is used for driving the horizontal rivets which hold the roof caps and sheets together. This riveter is equipped

(Continued on page 66)

Vaughn Hawthorne Promoted

A. C. Browning succeeds him as secretary of the Mechanical Division A. A. R.

V. R. Hawthorne, Executive Vice-Chairman



A. C. Browning, Secretary

THE long and constructive service of Vaughn Rue Hawthorne as secretary of the Mechanical Division of the Association of American Railroads has been recognized by his election to the newly created position of executive vice-chairman of that Division. Arthur Clark Browning, who has been associated with him as assistant to the secretary of the Division for many years, has been promoted to secretary. Changing conditions have very greatly increased the complexity and scope of operations of the Mechanical Division and Mr. Hawthorne's promotion is not only a well earned tribute to him, but also recognizes the enlargement and growing importance of the activities of the Division.

Mr. Hawthorne's association with the Mechanical Division took place under unusually trying circumstances. When Joseph W. Taylor, who, after 19 years of service as secretary of the American Railway Master Mechanics' and Master Car Builders' Associations, passed away in April, 1918, Mr. Hawthorne was made acting secretary. Coming into this position during the World War, when the railroad mechanical departments were operating under severe and unusual conditions, he found himself, a year later, faced with the task of going through a period of reorganization, when these two associations were merged to become what was then known as Section III—Mechanical, American Railroad Association.

It became necessary to thoroughly reorganize the work of the secretary's office. This he did "with energy and tact and with a vision of the future possibilities of a larger mechanical association." This quotation is taken from the Daily Railway Age of June 25, 1919. Its prediction of a larger mechanical association has certainly been fulfilled and that Mr. Hawthorne has met the greater responsibilities with success is indicated by the action that the General Committee has taken in advancing him to the newly created office.

Vaughn Rue Hawthorne was born at Oleona, Pa., November 27, 1886. After completing his high school education he attended the Elmira Free Academy, Elmira, N. Y. He entered the service of the Pennsylvania Railroad in June, 1904, as assistant storekeeper at Elmira. A year later he became a laborer in the Elmira shop of that road. After a short time he was promoted to car

repairer at Baltimore, Md. In 1907 he was appointed M. C. B. clerk at Baltimore and was later transferred to Williamsport, Pa., and then to Altoona, where he became lead clerk in the M. C. B. clearing house. He was promoted to M. C. B. inspector in 1915. In 1917 he went with the American Railway Association (now A. A. R.) as an inspector. In the spring of 1918, upon the death of Joseph W. Taylor, Mr. Hawthorne became acting secretary of the Master Car Builders' Association and the American Railway Master Mechanics' Association. In 1919 he was appointed secretary, when the two associations were combined as Section III—Mechanical, American Railroad Association.

A. C. Browning

Arthur Clark Browning was born at Belpre, Ohio, on July 15, 1884. He entered railroad service in January, 1906, as a trucker in the Chicago freight house of the Chicago, Rock Island & Pacific. Three months later he was advanced to yard clerk and in May of the same year entered the Chicago local freight office where he served as clerk, stenographer, assistant accountant and chief tonnage clerk. He was moved to the general office of the same railroad in August, 1917, as inspector of weights and later was employed as fuel clerk and general clerk in the office of the auditor of disbursements.

Mr. Browning entered the service of the former Master Car Builders' and American Railway Master Mechanics' Association as a committee reporter on February 16, 1919, shortly before their amalgamation as the Mechanical division of the American Railway Association, was made assistant to the secretary in July, 1919, and has served continuously in that capacity except for three years as a traveling mechanical inspector. For the past eight years he has edited the interchange rules and supervised matters pertaining thereto in the secretary's office, coming under the jurisdiction of the Arbitration committee and the Committee on Prices for Labor and Materials.

C. B. & Q. Builds A Thousand Box Cars

(*Continued from page 64*)

with a pair of rollers under the cylinder end and a shoe at the outer end which are designed to keep the dies in line with the center of the rivet hole in any position on the cap without raising or lowering the riveter. The riveter, thus equipped, can be readily moved to any desired position on the roof sheet and brought in line much quicker than would be possible with the overhead rail or balancing device ordinarily used.

At the riveting position, the furnace equipment, scrap air reservoirs partitioned off to hold various sizes of rivets, and the scaffolding arrangement are clearly shown in another of the illustrations. Still another view shows the jig used in applying battens to the 44-in. by 9-ft. 3¼-in. ceiling panels made of Douglas fir plywood. The panels are placed in this jig one at a time for the application of four battens per panel, a metal plate being built into the base of the jig at the near edge to clinch the nails as driven. Before applying the ceiling panels, the ridge pole and two sets of purlins are secured to the roof by bolts and metal clips. The ceiling panels are then applied, light and easily portable scaffolds being used to assist in this work. In nailing the battens, the steel backing-up bar with a long pipe handle is pushed in between the plywood and the car roof until it is over the transverse joint and the battens can then be nailed with every assurance that the nails will be clinched. Sub ridge poles and purlins are applied, the holding nuts being counter-sunk and filled in with plastic wood to give a finished appearance.

Car Axle Handling Device

To conserve floor space which is at a premium at the Havelock car shop, a unique car-axle handling device has been developed and installed which not only saves space but enables axles to be handled into and out of the axle lathe with practically no hand labor whatever. In this device, axles are loaded by crane on top of the machine and roll by gravity under suitable controls through five levels of a heavy steel-frame structure, made of 20-in. I-beam posts, 9-in. cross channels, 6-in. side channels and 110-lb. rail sections, the overall length, width and height being 11½ ft., 10 ft., and 8 ft., respectively. The axles are loaded by crane on the upper or fifth-level rails which have a slight incline and conduct the axles by gravity to an end plate which guides them to the fourth-level rails and similarly to the third-level rails which conduct the axles to the axle lathe at the same elevation as the lathe centers.

Referring to the axle lathe view, the operator releases two latches, *LL*, permitting the 28-in. extension bars *PP* (made of 2-in. pipe), to drop to a horizontal position and enable axle *A* to roll directly onto the lathe at a position very closely in line with the centers. A few revolutions of the hand wheel in the tail stock raises the axle slightly until it is supported between the lathe centers. After necessary machining operations are performed, a partial revolution of the hand wheel withdraws the nearer lathe center and a few more revolutions causes a hook attached to the tail center sleeve to engage the journal collar and pull the axle off the other dead center. The axle then drops by its own weight to a sheet-metal pan and rolls to the position shown at A_1 on the second level rails.

In the meantime, the pipe sections *PP* have been raised and latched and the operator exerts a lifting pressure on bar *M* which presses down lever *N*, the lower end of which serves as a stop to hold back the balance of the axles in the rack. When this stop is raised axle *B* rolls forward to position *A* and is then ready for handling to the axle lathe. Other axles in the rack follow axle *B* by gravity so that the only handling required is to load the axle rack by crane delivery of axles to the fifth level.

Referring to the second view of this device, the finished axles are delivered down the supporting bars at the second level, being retarded or stopped at the outer end by two positive stops and by brake bars *BB*, the pressure of which on the axles can be controlled by pressing down or releasing handle *H*. The first level supporting bars are used for temporary storage of the finished axles while waiting to be mounted.

This axle rack holds 55 axles ready for delivery to the lathe and 40 machined axles. It is designed for 5½-in. by 10-in. axles which are received rough-turned from the steel mills. The operation performed in the axle lathe, illustrated, consists simply of turning the wheel seats and on this work the production is about 51 axles in 24 hrs. Car wheels for this number of axles are bored and mounted on one 5-hr. shift and the wheels and axles then move to another lathe where journals are finish turned and rolled.

HIGHWAY PATRIOTISM?—The various groups in Washington, interested in securing large federal appropriations for their particular hobbies, have shown no disposition to moderate their demands—to enable the government to concentrate its expenditures on the defense effort. According to an Associated Press dispatch on December 30, "highway construction advocates have gone ahead with plans calling for little if any reduction."

EDITORIALS

Mechanical Association Conventions

The editorial comment in our January number, entitled, Mechanical Associations Frankly Challenged, has stirred up some interesting and also some unexpected reactions. The Car Department Officers' Association, as an example, in a statement on another page, courteously but, nevertheless, firmly takes exception to our use of the word "challenged." Cutting the length of the meetings from four to two days it says, "may be considered more of a suggestion for greater efficiency than a challenge." Fine! The officers of that association have already started to roll up their sleeves and the Master Boiler Makers may have to look to it to maintain their record for long and strenuous sessions.

Most of the comments that we have received, and we are able to publish only typical ones, are strongly for preprinting the reports and distributing them far enough in advance of the meetings so that they may be studied and digested. There seems to be a little question about this procedure in the minds of the Car Department Officers' Association. If you don't do this, however, and if you send advance copies of the reports to only a few of the key members, will it not be necessary to read the reports in full at the meetings, instead of presenting them in brief abstract? Moreover, if the members have the reports in advance and understand that all of the time at the meetings will be used for discussion purposes, will it not be likely to draw a heavier attendance, and will the meetings not be much more interesting? Is it not true that most of the members are not trained to follow reports critically when they are read to them, whereas, if they have studied them in advance they are quite likely to follow the discussions on the floor with keen zest. This is particularly true if key men are asked in advance to "break the ice" and get the discussions started promptly.

Reports from the field indicate that before we went to press three of the associations had already held meetings of their officers to revamp their programs to fit into the two-day schedule. They have also made plans to speed up the committee work, in order to insure the completion of the reports by the middle of June. This will allow ample time for printing and mailing, so that they will reach the members far enough in advance of the conventions to be carefully read and studied.

Meanwhile, the *Railway Mechanical Engineer* plans to maintain close touch with the associations and to keep its columns open during the coming months for suggestions from our readers as to how they believe the meetings can be made of maximum practical benefit to them. Two pertinent communications will also be found on "The Reader's Page" of this number.

Diesel Installations Hit High Mark in 1940

From the standpoint of progress in the installation of Diesel motive power in railroad service the year 1940 was of exceptional interest for several reasons. During last year the railroads of the United States placed in service a greater number of Diesel-powered locomotives than in any year since the first Diesel switcher was installed in 1925; the total number of units installed in 1940—410—was almost double that of the previous year, which in itself was a record year; the number of units in road service—70—was almost equal to the total of the previous five-year period and the total horsepower installed exceeded the total of the previous five-year period; the total number of units now in service—1,011—have an aggregate engine horsepower of 1,006,320; the year 1940 witnessed the installation of eight units of 21,600 aggregate horsepower in main-line freight service on Class I roads.

The influence of the Diesel locomotive in the switching field has been particularly interesting. In the January, 1940, issue, the progress of the Diesel in that class of service was analyzed and it may be worth while to summarize the analysis made at that time as an indication of future trends. At the end of 1925, the year in which the first Diesel switcher was installed, there were three Diesel switchers having a total of 1,200 hp. in service. At the same time there were 10,702 steam switchers having an aggregate tractive force of 361 million pounds. In 1930 the total number of Diesel switchers had increased to 73 with an aggregate horsepower of 26,940.

The year 1930 seems significant in relation to steam switchers for that was the high point in aggregate tractive force—387 million pounds—in spite of the fact that ownership of that type of switching power had by then decreased to 10,268. In the six-year period ending with 1930 the roads had ordered over 800 steam switchers of increasingly high capacity, which accounted for the high aggregate tractive force with a decreasing total ownership. From 1930 the retirements of steam switchers and the fact that only 108 units of that type have been ordered in the last 10 years have resulted in a constantly decreasing ownership and aggregate tractive force.

At the end of 1934 the Diesel switchers in service totaled 113 with a total engine-horsepower of 47,600 and the comparative figures for steam switchers was 8,712 owned with an aggregate tractive force of 342 million pounds. During the five-year period ending December 31, 1939, there were 488 Diesel switchers installed bringing the total horsepower to 397,380 lb. and 93 steam switchers were ordered and 1,203 retired resulting in an aggregate tractive force of 306 million pounds for that class of power.

At the end of 1940 there were 941 Diesel switchers in service with a total engine horsepower of 638,020. The average Diesel locomotive horsepower has increased from 450 in 1929 to 678 in 1940. As of June 30, 1940, the ownership of steam switchers had further decreased to a total of 7,395 with an aggregate tractive force of 303 million pounds.

Between 1930 and 1940 the total ownership of steam switchers was reduced by about 2,800, and the ownership of Diesel switchers was increased to over 900. The reduction in aggregate tractive force of steam switchers, during the same period, was about 84 million pounds. At an average of 53,700 lb. about 50 million pounds of aggregate tractive force was replaced by the introduction of the 900 Diesel units. An appraisal of these two sets of figures would seem to bear out the estimate that a Diesel switcher will replace between two and three steam units.

To complete the record, the installation of 70 road Diesel locomotives in 1940 brought the total of road locomotives of this type up to 143 having a total engine horsepower of 368,300. The average road Diesel locomotive has 2,580 hp.

Signs of Preparation

In the January issue attention was called to the probable trend of freight traffic and car loadings during 1941. It was roughly estimated that to handle successfully a prospective fall peak averaging 900,000 or more carloads weekly for the four highest weeks, the Class I roads would need a net increase of at least 40,000 more freight cars than they owned at the time of last fall's peak. Based on the rate at which retirements have been continued during a number of years past, this would require the acquisition of as many as 100,000 new cars.

To increase in the number and aggregate capacity of freight cars owned by the Class I railways has required a reversal of the trend in ownership, which has been consistently downward ever since the beginning of the depression; indeed, it had started down even before that. From the end of 1932 the number of Class I freight cars decreased from 2,172,000 to 1,672,000 at the end of 1939—a net reduction of 500,000 cars in seven years and a net reduction in carrying capacity of 18.9 million tons. The decline had been continuous both as to the number of cars owned and as to the aggregate tonnage capacity.

Considering box cars alone, the same situation had prevailed; that is, the record of decline in the number of cars as well as in their aggregate capacity had been unbroken. In the case of open-top cars there was one break in the downward trend. During 1937 there was an increase of several thousand open-top cars and an even greater proportionate increase in aggregate capacity tonnage. The downward trend was resumed the next year, however, and continued until the end of 1939.

Last year occurred the first sign of a reversal in this downward trend in freight-car capacity. Car Service Division reports show an increase in the total cars on line of the Class I railways of over 6,600 between January 1 and June 30, and an increase in aggregate tonnage capacity of 614 thousand. During this period retirements amounted to over 36,000 cars, which is at a rate equal to the average of the three years 1937 to 1939, inclusive.

If these results of the actions of the railroads in 1940 may be considered any criterion of the policies which they will carry out during 1941, it seems evident that there will be no sharp curtailment of retirements and that new cars will be ordered in sufficient numbers to meet the needs of the railways for a continuance and acceleration of the net expansion of freight car capacity which began last year.

A Boiler Of Unusual Proportions

On another page in this issue is a description of an articulated freight locomotive for the Western Maryland, the boiler of which is of unusual interest. The article in question points out several noteworthy features of construction; it is to the proportions of the boiler that attention is directed here.

The firebox is over 17 ft. in length at the mud ring and a combustion chamber extends into the boiler barrel an additional 8 ft. With the Gaines wall in place the combustion chamber is approximately 11½ ft. long from the back of the wall to the tube sheet. The firebox thus has an unusually large combustion volume. With the five Thermic syphons—three in the firebox and two in the combustion chamber—the proportion of total heating surface in the firebox is the largest of any articulated locomotive built in recent years. The total firebox and combustion-chamber heating surface amounts to 10.61 per cent of the combined heating surface. The closest approach to this by any other locomotive is the Northern Pacific 4-6-6-4 type, the first of which were built some four years ago. Here the firebox heating surface constitutes 10.56 per cent of the combined heating surface. Probably considerably more

than half of the total evaporation will be effected by firebox and combustion chamber heating surface, which in turn means a high average evaporation per square foot of total evaporative heating surface.

Taking Guess Work Out of Front-End Design

She doesn't steam! She "chokes" herself! What to do? Why, change the exhaust nozzle, of course, or perhaps the stack extension needs adjusting. Too frequently, this has been the solution, regardless of the cause, to such a report from the engine crew or the travelling engineer. Though faulty operation, improper firing practices, poor grate design, and other factors may have been responsible, the exhaust nozzle is often the "scapegoat" and, at the same time, the "cure-all" for a poor performance.

Concealed from prying eyes, the action of the gases and exhaust steam inside the smokebox has always aroused the curiosity of those concerned with locomotive design and operation. For practical reasons, a knowledge of the effect of changes in the front-end arrangement is more important than knowing the details of just what takes place before the gases and steam are finally exhausted to the atmosphere. As a means for studying the effect of various front-end designs on boiler performance and exhaust steam pressure, the report on standing locomotive tests developed by the New York Central and presented before the annual meeting of the Railway Fuel and Travelling Engineers' Association last fall in Chicago, the first part of which appears elsewhere in this issue, deserves the attention of those interested in improving boiler and engine efficiencies.

In an effort to duplicate road conditions in the standing tests, the New York Central devised a method for controlling the temperature as well as the pressure of the exhaust steam. That it succeeded in doing so is indicated by a comparison of standing test results with those of an actual dynamometer car road test of the same locomotive. The results are almost identical. This is of importance because of the many times that road performances have failed to meet those obtained under test conditions. The investigation of front-end design by this method has distinct advantages as the effect of minor changes can be determined without incurring the inconveniences or cost of road tests.

The detailed study of the many parts in the front-end arrangement, both separately and in their relation to each other, made possible by the standing tests resulted in a remarkable improvement in the boiler evaporation and a decrease in the exhaust steam pressure. Changes in the size of the exhaust nozzle were not dictated by the whims of the engine crew or the fancied notions of a travelling engineer. The design of each part had to prove itself under scientific observation before it was accepted as that producing the greatest efficiency.

The standing locomotive tests showed that a change in one detail or dimension of the component parts definitely affects the performance of the others. Changing one part requires corresponding adjustments in others, if they are all to produce maximum efficiency. This explains why, once tinkering has been permitted, improvements in the performance of individual locomotives can be effected by further tinkering, even though the final result will be much below the best. After developing a satisfactory front-end design care should be exercised to see that the standard is strictly maintained even though it may require a lock on the smokebox door.

New Books

MASTERING MOMENTUM. *By Lewis K. Sillcox, D. Sc. Published by the Simmons-Boardman Publishing Corporation, New York. 274 pages, 130 illustrations, 6 in. by 9 in. Cloth binding, $2.50.*

This volume is an adaptation of material contained in six papers privately published and presented under the general title "Mastering Momentum" at the Massachusetts Institute of Technology over a period of several years. There are six chapters. The first, and by far the most extensive, deals with the mechanics of train operation and train braking. This is a condensed survey of braking developments and braking problems. In it will be found descriptions of methods employed in calculation of stopping time and distance curves as well as those involved in the operation of the brake itself. Other chapters deal with railway car wheels, railway car axles, locomotive and car-truck design, and draft gears. Each chapter contains a wealth of information of value to the student. Much of it is also valuable reference material for those engineers not specialists in the subjects treated. The reference value of the book is enhanced by a topical index.

FUELS AND THEIR UTILIZATION. *By A. R. Carr, dean of the College of Engineering, and C. W. Selheimer, assistant professor of chemical engineering, Wayne University, Detroit, Mich. Published by the Pitman Publishing Corporation, Two West Forty-fifth street, New York. 184 pages, illustrated. 6 in. by 9 in. Price, $2.*

No attempt is made in this book to go fully into thermodynamics, but the various fuels which, in current practice, are available for the production of heat, the means by which they are utilized for this purpose, and modern investigations and tests to increase and maintain efficiency in the production of heat are fully discussed, with particular attention to both principles and applications. Fuels, both liquid and solid, are classified, and their properties and characteristics described. Chapter II is devoted to laboratory experiments.

Suggestions for Mechanical Associations

Someone to Start Discussion

The one thing that struck me most forcibly at the Car Department Officers' convention, which I attended, was the manner in which the discussion was opened up. Probably this association is the one you had reference to, as they seemed to have a man ready to start each discussion.

Closer Co-ordination Suggested

The consolidated conventions should have a general subject committee to line up a co-ordinated plan. It is my thought that there should be more joint sessions where prominent speakers should address the entire convention, and probably have a consolidated banquet with a dinner speaker. When I refer to "prominent speakers" I have in mind men who can make a "speech" and not "read a paper."

Portable "Mikes"

There is one suggestion which I would like to present for your consideration. You know, from having taken an active part in the meetings, that the chairman usually insists that the microphone be used by anyone taking part in the discussion. I consider this essential for any meeting involving the number present at meetings of this association [Fuel and Traveling Engineers]. However, some valuable discussion is probably lost because of the hesitancy of some the members to walk to the platform and speak into the microphone. If one or two portable microphones attached to long leads were available so that they could be quickly handed to any member wishing to take part in the discussion, the remarks would probably be more lively, interesting, and would not necessarily consume more time.

Equipment Failures And Train Detentions

During the past decade I have witnessed many changes in the railroad industry, particularly with respect to car department matters, and it is apparent that the Car Department Officers' Association is doing a fine job in bringing valuable information to its members. Our young men are certainly given every opportunity to acquire knowledge and it seems to me we should do our part to encourage them in their work and inspire in these young men the will and desire to promote greater efficiency in their specialized fields. While many boys will come to us with a fund of technical knowledge, they will lack in experience and that is where we must not fail them.

I was particularly interested in the discussion on equipment failures causing train detentions, notably the high percentage of failures attributable to hot boxes. For many years railroads have had this serious problem to deal with, and will continue to have, though perhaps to a lesser extent, just so long as we have the present journal box assembly. Nevertheless, it has been our experience that such failures can be greatly minimized by insisting upon proper preparation and application of packing and careful attention to other details, as set out in A. A. R. Rule 66. To attain that objective, however, there must be constant policing to see that shop, yard and renovation practices are of continued high order.

Practical Value of the Conventions

The writer was educated as a civil engineer, but during the past twenty years has devoted a large share of his time to the study of boiler feedwater treatment and particularly the effect of good water, as far as improved locomotive operation is concerned. From personal contact with the men directly responsible for boiler conditions, I can see a great need for men who have imagination, vision and new ideas. There seems to be no better place where the men, who necessarily spend a large share of their time in the smoke and soot of a roundhouse, can enlarge their ideas to better advantage than by attendance at meetings of this kind.

The advantage of any convention is not primarily in listening to the formal reports, but rather in taking part and hearing the discussion which the reports bring out. Another valuable advantage is by reason of the contacts which these men make with men from other railroads and other districts of the country, who have similar problems but look at them from a different angle. I have personally noticed how men who never attracted attention before, blossom out with new ideas—and how they quickly advocate improved practices which they heard some co-worker from a distant railroad describe at the convention they attended.

Sending a man to a convention and instructing him to make a report at the next general mechanical meeting in his district goes a long way toward the development of a good man. As I listened to some of the discussions, I realized that each man was talking from the bottom of his heart about things of vital concern to his work, to his railroad and to his job, and what can be more worth while? Let no one think that a convention trip is just one of pleasure for those men who are really accomplishing things on the railroad. The right men attending a convention work much harder than they would at their regular routine, and never fail to bring back good ideas both for themselves and for their employers.

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Comments from readers on suggestions made in our November, 1940, number for making more effective the efforts of the Mechanical Department Associations. See also January number, page 25.

Two Good Suggestions

Your editorial comments on the meetings were of great interest and value, particularly those concerning the starting of the meetings on time and the stimulation of discussions. It is suggested that these two matters be again stressed so that the meetings in 1941 will be of even more value than those of last October.

Concerning Speakers

The selection of a person to deliver a paper should depend upon a number of factors. Such a person, to be effective, should be not only as a matter of duty interested in his subject; he should, if possible, even be a "bug" on the subject. His interest should be vital, active, and his viewpoint different from the conventional. Further, he should be made to understand when approached for a paper, that what is of interest to an audience is not the hide-bound conventional viewpoint which everyone has been hearing for years, but new slants or radical perspectives, which may be foreign to his audience, but which will at least stir up interest and bring out discussion.

Short, Snappy Sessions

Your comment relative to starting meetings on time is timely, but I have always been a believer in short, snappy sessions. There are always some in attendance at conventions who are not interested in some of the subjects, but at the same time are very much interested in others. I believe that most sessions are too long to command the greatest interest. I believe that a two-day meeting, sessions starting at 10:00 a. m., adjourning at 12:30 p. m., reconvening at 2:00 p. m. and adjourning not later than 5:00 p. m., with all sessions opening and closing promptly, will do much toward getting members in their seats and keeping them there. You know, after all, the personal acquaintances that we make at these conventions are in some cases invaluable, and if you start meetings too early we don't have a chance to meet the men we would like to meet.

THE READER'S PAGE

Endorses Mechanical Associations

To the Editor:

Acting on your request for comment and suggestions concerning increasing the effectiveness of the railroad mechanical associations, I believe it may well be said, from observation of the activities of the several associations in convention, that they are fine organizations, doing work of the highest type. One interested in mechanical matters can only express commendation on the valuable service they strive to render and are doing in the field of railroad mechanics.

Apparently increased effectiveness and continued growth depends primarily upon three distinct factors: (1) leadership, (2) enthusiasm, (3) support.

However, to justify the need for existence there is a definite service obligation to meet, demanding careful choice of officers and thoughtful selection of active committees and topics for discussion.

The advantage of centralization of the conventions with an appropriate railway supply exhibit, as to time and place, is immediately apparent and will insure better attendance with correspondingly increased interest.

To extend the membership is essential, and endorsement of the true value of such associations by railroad mechanical department executives and the railroad managements is sought solely on the basis of tangible benefits accruing from membership participation. Recognition of factual benefits will bring needed co-operation and greater assurance for the provision of active membership.

Active participation in discussion is essential in committee deliberation and on the convention floor and should be further encouraged. Added interest in this respect may be aroused through the selection of key spokesmen. The individual member brings to the committees, and to the convention, an implied inquiry from his railroad for information and his interest and ability to absorb facts developed in such meetings will determine his representative value to that railroad and to the association.

The printed proceedings of these associations offer strong inducement for membership, presenting vast educational values to every progressive mechanical employee, far in excess of the nominal membership fee.

The future of these associations may be summed up thus: Their effectiveness is dependent upon combined individual effort and under continued efficient leadership will make an invaluable contribution to the railroad mechanical department.

Through your columns you can stimulate interest in these various organizations and urge the managements of the various railroads and private car lines to permit their supervisory officers to attend and participate in such association activities.

As one having attended some of their recent conventions, I appreciate this opportunity to comment from personal observation.

O. A. Garber,
Chief Mechanical Officer,
Missouri Pacific Lines,
St. Louis, Mo.

Car Department Officers' Comment

To the Editor:

Regarding the editorial which appeared in the January *Railway Mechanical Engineer,* entitled "Mechanical Associations Frankly Challenged," the action of the A. A. R. General Committee, in reducing the length of the convention to two days, may be considered more of a suggestion for greater efficiency than a challenge. In their daily occupations, railway car supervisors are continually finding it necessary to develop and adopt methods and procedure to increase efficiency. Surely the same deliberate goal should be sought in conducting the affairs and activities of the Car Department Officers' Association.

The C. D. O. A. program for the 1941 Fall meeting was rather completely developed before the action of the General Committee. Although it was built up with the thought that the convention would take more than two days, only subjects of importance and immediate urgency were included. As the situation looks now, there is but one answer. Start the sessions early; take less time out for lunch; and hold longer sessions, as is done at many individual railroad staff meetings. Let's make the 1941 convention another constructive and important inter-railroad staff meeting.

As to the pre-convention distribution of individual papers and committee reports, there are arguments both pro and con. Is it not likely that, if all of the papers are made available to all of the members in advance of the meeting, some members may feel that they do not need to attend? Would it not be better to make individual papers and reports available to a limited number of men capable of analyzing each and qualified to develop important supplementary information and join in the discussion on the floor? A number of C. D. O. A. officers believe that this policy will add to the value of the papers, develop a more representative experience and expedite the handling of the subjects.

As to the addresses, the general thought appears to be that they should not be eliminated entirely, thus taking from the programs much of the lasting inspiration that has characterized them in the past. Railway car men frequently take the published Proceedings and read one or more of the addresses which they heard at the last annual meeting. Even from the coldly impersonal type, they get inspiration from the words of the distinguished men in the railroad field who have graced the speaker's platform and presented words of experience and wisdom.

The officers and members of the C. D. O. A. can look back in the quite recent past to the accomplishment of a number of tasks much more imposing and difficult than that of "putting on" a successful two-day program at the annual meeting next Fall. The more they think about it, the more they are convinced that an opportunity is being presented to set up new standards in the effective organization and handling of annual meetings.

Publicity Committee
Car Department Officers' Association

"Then tell me," Evans laid the train-gram on Dirk's desk, "What in the hell is the meaning of this?"

A NEW BROOM

by **Walt Wyre**

"MAYBE we'll get a little service now," Jim Evans, roundhouse foreman for the S. P. & W., remarked when he learned that the division store department was to be moved to Plainville. "At least," he added, "we should be able to get two machine bolts of the same size and length without waiting for one of them to be ordered."

"Getting a new storekeeper, too," John Harris, the roundhouse clerk, said.

"Yes, a man by the name of Dirk," Evans replied. "Don't remember ever having heard of him." The foreman left the office and went to the roundhouse to see how things were going.

The new division storekeeper reached Plainville at 10:30 that morning and went directly to the roundhouse. He was in the storeroom office when Evans went to see about booster parts for the 5081.

"I'm the division storekeeper," Dirk said when Evans entered. "My name is Dirk," he added, thus implying that his title was more important than the name.

"Glad to know you, Mr. Dirk," Evans acknowledged the introduction. "What I'm interested in now is parts for the booster on the 5081."

"I'll get right after them," Dirk said. "Just as soon as I get straightened around, I'll look up the requisition and wire for them. I'll have them here right away."

While the two were talking, Ned Sparks, the electrician, came to the storeroom. "How about a half-inch LB condulet?" Sparks asked the counterman.

"Haven't got it," the counterman replied after he had looked.

"Let's see if you've got anything I can use." The electrician opened the gate and went to the electrical rack. "Guess this LR will do," he said. "Better change that requisition."

When the electrician had left, Dirk went out and snapped the lock on the gate to the storeroom. "No one but store department employees should be allowed in the storeroom," he told the counter man.

"Well, I guess I had better go," Evans said. Dirk didn't get the point until the foreman was half way back to the roundhouse.

The new storekeeper spent the rest of the day looking through the stock and commenting on the apparent inefficiency of his predecessor. Everything was arranged wrong; there was either too many or too few of every item. In fact, if Dirk noticed anything in the storeroom that was right, he failed to mention it. He was so busy finding things that needed correcting he forgot to order the parts that Evans was needing for the booster. Dirk was particularly annoyed when he found a miscellaneous assortment of material on top of a material rack in the rear of the storeroom. "What's all of this?" he asked the counterman.

"That's all charged out," the counterman replied. "They are parts that are not used often and the foreman charged them out so they wouldn't show in our stock. Makes the record book better by keeping the inventory low."

"Well, it won't be done that way any longer. If the mechanical department wants the stuff, let them take it to the roundhouse," Dirk said. "If they don't want it, ship it in for credit. We're not keeping dead stock in the storeroom. I want you to start tomorrow cleaning out everything that doesn't show consumption for the past sixty days."

"How's the new storekeeper?" John Harris asked when Evans returned to the roundhouse office.

"O. K., I guess," Evans replied. "He acts like he has a cockle burr under his tail, but seems to know his business."

The storeroom was a busy place the next few days, cleaning, painting, changing things around like a housewife on the first warm day of spring. And likewise, no one could find anything in the storeroom. A machinist sent to the storeroom for six 5/8 by 4 inch studs. After searching thirty minutes while the machinist and helper waited for the studs, the material man gave up and another hour was lost while a machinist made them on a lathe. Next day the studs were found where some one had misplaced them in a bin with 3/4 in. studs.

Evans waited four days for the booster parts he needed and decided it was time the parts were showing up.

"They should be showing up any minute now," Dirk said. "I'll wire about them again. Come in and take a look at the storeroom," the storekeeper said to change the subject.

"Looks right nice," Evans commented, "but the parts for that booster would look better to me. Guess I'd better get back to the roundhouse and rush the boys up a little on the 5082," the foreman said as he left.

The foreman went to the roundhouse but didn't say anything to the men working on the 5082 because everything seemed to be going along nicely. The engine was over the drop pit for classified repairs. The machinist was just about ready to start putting the wheels up. Leaving well enough alone, the foreman started down through the house. The outbound inspector came rushing in looking for a pipefitter and saw the foreman.

"Air pipe broken on the 5076," the inspector panted. "It broke just as the crew started to run the engine out to get on the train."

Evans looked at his watch. "I'll go through the house and out to the engine. You go the other way. If you find a pipefitter, tell him to grab some tools and come running."

A pipefitter reached the engine almost as soon as the foreman. "We'll need a three-quarter street ell," he told the foreman.

Evans wrote out a requisition and handed it to the pipefitter's helper. The helper left at a run. Five minutes later the helper returned empty handed. "Didn't have any," he said.

"Why didn't you get an ell and a close nipple?" the pipefitter asked.

"The storeroom man wouldn't have let me have them, said he would have to have another requisition, order from the division storekeeper," the helper added.

"I'll get them," Evans said and sounded as though he meant exactly that.

There was a fifteen-minute terminal delay on account of the broken air pipe. Evans didn't exactly lose his temper, but he exercised it a bit.

Work on the 5082 was going along nicely. The first pair of drivers were up and the second pair on its way. Machinist Cox was under the engine watching to see that everything was in place. His helper was handling the push button switch. The motor was humming merrily, the table bearing the drivers was coming up, when Cox noticed that one of the driving boxes wasn't in line. "Stop it!" Cox yelled.

In order to stop quickly, the helper pressed the "down" button reversing the motor. Neither of the men noticed the slight rattle that followed when the motor was reversed.

The machinist straightened the driving box. "O. K., raise it up," he said.

The helper pressed the button. The motor started, but instead of running smoothly as before, there was a terrific rattle. The table jerked as though it were locked and the helper released the switch button.

"Sounds like a stripped gear," Cox said.

"Yes, I guess that's what happened," the helper agreed. "I noticed the fibre gear on the motor was getting pretty badly worn a few days ago."

The helper was right. The fibre gear on the motor was stripped. Only a little ring of teeth on one end was left on the gear.

"Take the guards off from around the gears," Cox told the helper. "I'll go tell the foreman."

"Well, it could be worse," Evans said. "It won't take long to put on a new gear and there's one in the storeroom. I ordered it six or eight months ago and gave the storekeeper a requisition for it when it came in. Go down to the storeroom and get it."

"What can I do for you?" the counterman at the storeroom asked when Cox entered.

"Give me the fibre gear for the drop-pit motor," Cox replied.

"Got a requisition?" the storeroom man asked.

"No; don't need any. It's already paid for, and I'm in a hurry," Cox added.

"Is the gear you want one that was on top of the last rack?"

"Yes, that's it, the fibre one," the machinist was beginning to get slightly impatient.

"If that's the one you want," the storeroom man said, "it's not there any more."

"What do you mean, not there?' Cox started to open the gate to enter the storeroom proper, but it was locked. He climbed up on the counter and slid down on the other side.

"Hey!" the counterman said. "The storekeeper will raise thunder if he sees you in here—nobody allowed in here but storeroom employees."

"Let him raise!" The nut-splitter continued walking towards the rear of the storeroom. "If you won't get the gear for me, I'll get it myself. Where is it?"

Division storekeeper Dirk in his adjoining office heard the loud talking in the storeroom and went to see what was causing the commotion. "Say, didn't I tell you not to allow any one to come in the storeroom but store department employees?" he said to the counterman.

"Yes, but——"

"He didn't do any allowing," Cox interrupted. "I just came in. Where are those gears for the drop pit?"

"When you want material just give your requisition to the man at the counter. He'll get it for you," Dirk said with emphasis.

"Say, listen, I'm not going over all of that again! Do I get the gear or not?"

"He means that fibre gear that we sent in," the counterman explained.

"You mean it's been sent in!" Cox exclaimed. "There'll be hell about that!"

"We can't keep dead material on hand," the storekeeper said, "if you needed that gear you should have taken it when it came in."

But Cox wasn't listening. He was already on his way back to the roundhouse.

A Missouri mule skinner could have learned some new wrinkles in streamlined profanity when Evans learned that the gear had been sent in. He was so mad he never even knew when he swallowed his chew of horseshoe. "First the parts don't get here for the booster, then the drop-pit breaks down and the storekeeper has sent the gear back! If that's railroading, I'll take jerking soda," the foreman complained, but Evans learned long ago that little is accomplished by idle talk. After the outburst he began to figure some way out of the predicament. He climbed down in the drop-pit and looked at the old gear.

"Get it off," he told the machinist, "and take it to the machine shop. And don't batter it up." Evans climbed out of the drop-pit and went to the storeroom.

It was characteristic of Evans that he said nothing to the storekeeper about the gear when he reached the storeroom. There were two reasons. He wanted time to cool off and time spent arguing would delay getting the drop-pit going. "Got any sheet fibre?" Evans asked.

"No," the man at the counter replied, "but the electrician has a big piece of it."

Evans went to the electric shop. The big piece of fibre was two feet square and three-quarters of an inch thick. The electrician had ordered it to make a test panel. "I'll tell the storekeeper to order another piece," Evans told the electrician.

When the foreman reached the machine shop he found Cox waiting with the damaged gear. Measurement of the strip that still had teeth left on it showed the gear to be slightly over nine inches in diameter and it was four inches thick.

"Not enough fibre," Cox commented.

"By putting a piece of brass half an inch thick on each side we can just make it," Evans said. "Take the fibre to the car department mill and cut out four circles about eleven inches in diameter. That will leave some material to work on."

While the machinist was cutting the fibre into discs, Evans had a machine man turn out two round brass plates exactly the diameter of the outside the gear was to be with holes in the center the same size as the motor shaft. The foreman then laid the two brass plates together and using washers to keep the bolt head and nut from slipping through the holes bolted the two brass plates securely to the old gear with the good edge of the gear next to the brass plates. With the old gear as a guide, holes were drilled between the gear teeth.

By the time the job was finished, Cox returned with the four fibre discs, but the foreman wasn't quite ready for them. Leaving the brass plates bolted to the old gear for a pattern, Evans told the machinist to cut the teeth in the brass plates.

It was slow tedious job sawing and filing the inch thick brass to the exact contour of the gear teeth. The five o'clock whistle blew before the job was finished but it was finally done.

Next the plates were bolted on either side of the four fibre discs using six half-inch bolts in a circle just below the bottom line of the teeth. A light coating of glue was applied to the fibre before being bolted together.

While the machinist was working on the gear, Evans went through the house, checked up his work reports and did a dozen other odd jobs that had to be done. At the roundhouse office the clerk told him the dispatcher was wanting an engine for an extra drag of empty reefers sometime the next day.

"Looks like we'll have to get the 5082 finished tonight," Evans said as he went back to the machine shop to see how work on the gear was progressing. Cox had it all bolted together when the foreman got there and was wondering what to do next.

"Take it to the drill press and drill an inch and a half hole through the fibre," Evans told him. "That will leave enough to true up. I'll go get a bolt to use for a mandrel to put it on to turn the outside."

The outside of the fibre was turned down to the diameter that the finished gear was to be, then taken off the mandrel, chucked, and the inch and a half hole bored out to the finished side to fit the motor shaft.

"Are we going to cut the teeth by hand like we did the brass?" Cox asked.

"No, take it to the drill press and drill out between the teeth like you did the brass, then take it down to the mill and saw out as much of the remaining fibre as you can on the band saw. Don't try to get too close, though, and let the saw hit the brass," Evans cautioned.

A coarse file was used to remove the remaining fibre and shape up the teeth, then a finer file was used to smooth them up.

"Makes a pretty good looking gear," Cox remarked as he was finishing smoothing the teeth. "How are we going to cut the key way?"

"Take four power hack-saw blades and bolt them together with stove bolts," Evans said. "Rough out the key way with them and square it up with a file."

The foreman stayed on the job until the gear was driven on the motor shaft and tried out. It was slightly noisy at first until the high spots wore off, but it worked. A night machinist finished putting up the wheels and the 5082 was ready for the drag at 2:30 the next day.

"Just got a wire about your booster parts," the division storekeeper told Evans that day. "They'll be shipped tomorrow."

"You said you'd get action," Evans replied. "I had just about given up hope of ever getting them."

"Everything is slow now. It's hard to get material with this defense program going on," Dirk said.

"Well, in that case, seems to me it might be a good idea to keep material that might be needed, instead of sending it back—the gear for the drop-pit motor, for example," Evans replied dryly.

Everything went along fairly well for the next two or three weeks. The material problem was about normal, then the gasoline-electric portable crane stripped the gears in the differential.

Several months before the machine had given trouble with the differential. It was torn down and the drive pinion found to have a tooth knocked out. The other gears were not in very good condition at the time but

there was a drive pinion in the storeroom and the other gears had to be ordered. The drive pinion was replaced and the other gears ordered. The portable crane continued to run and no convenient time could be found to put the gears in as long as the machine would operate, and the crane differential gears went along in the same car with the drop-pit gear.

Perhaps it was best for all concerned that the storekeeper was out when Evans went to the office. The foreman took the parts catalog and marked the gears to be ordered and showed the stockman just what he needed.

"O.K., I'll wire for them right now," the stockman promised.

Dirk came in just as the stockman had finished typing the message and laid it in the basket.

"What's that?" the division storekeeper asked.

The stockman explained about the gas-electric crane being tied up for parts and that the machine was badly needed.

"I'll handle it," Dirk said in a tone that indicated no one else was capable.

Evans waited two days then asked Dirk about the gears.

"They should be showing up any time now," the storekeeper said. "Maybe they are at the passenger station now."

They were not at the passenger station and there was nothing to indicate when the gears would be there.

In the meantime if the portable crane had ever been needed in the roundhouse at Plainville, it was needed then. In fact it seemed that there were more things to be moved than ever before and the crane was standing in one corner of the machine shop with its rear end resting on wooden blocks useless as a tissue paper parasol in a cloudburst.

Four days after the machine broke down Evans received a traingram from the roundhouse foreman at Middleton. "Have received a traingram from division storekeeper Dirk asking if we have gears in our motor car parts that can be used in gas-electric crane differential. There must be some mistake somewhere."

Evans read the traingram through twice before he got the meaning, then he headed for the storeroom.

"Did you wire for those differential gears for the portable crane?" Evans asked Dirk.

"Why, yes, I ordered them that day."

"Then tell me," Evans laid the traingram on Dirk's desk, "what in the hell is the meaning of this?"

"Why, they maintain two gas-electric motor cars at Middleton and I thought they might have some gears there that would do—might get them quicker."

Evans swallowed hard, bit his tongue, counted ten, and was still mad, but he managed to keep his voice even.

"Don't you know that rail motor cars don't have a differential? Even if they did, they wouldn't fit a portable crane. I marked the parts needed and saw the stockman start to make a wire ordering them, and I'm wondering why the wire wasn't sent."

"I've already wired for them," Dirk replied. "You don't seem to appreciate that I was trying to save time and money for the company."

"Well, this is the second time we have had unnecessary expense in the roundhouse because the store department sent in parts that I had ordered." Evans didn't raise his voice but his tone was hard.

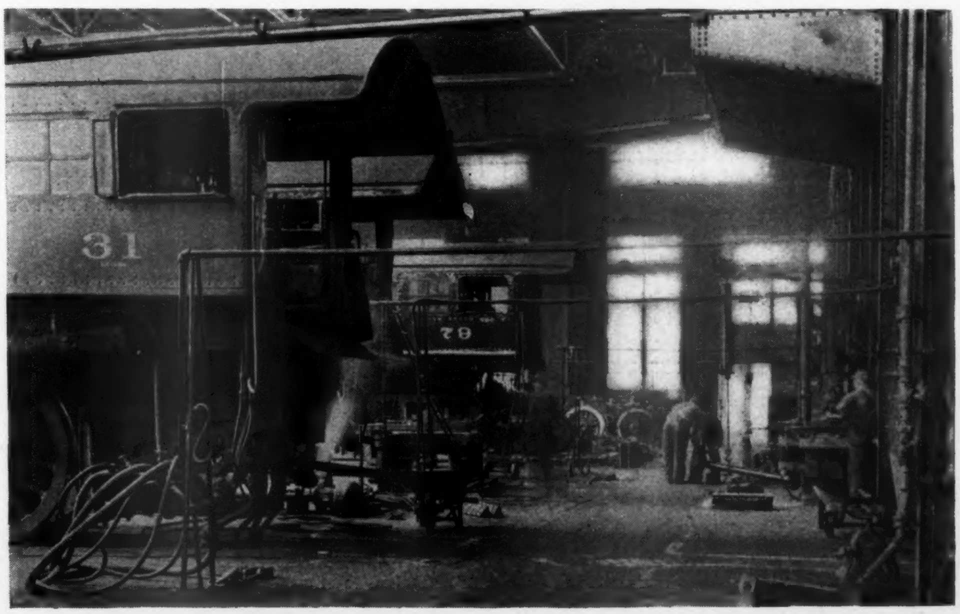
"The store department can't keep dead stock on hand. If material isn't used, we've got to sent it in. It makes our record look bad if we don't."

"Maybe I'm wrong," Evans said, "but you know I've always had an idea that the store department was operated to supply material for other departments, the mechanical department being one of them. Which is more important, a few dollars worth of dead stock in the storeroom or dead engines in the roundhouse waiting for parts?"

Evans left the office while Dirk was trying to think up a reply.

Supports and Racks For Welding Hose

Many railroad shops are so arranged that when oxygen and acetylene stations are installed they are located on columns across a runway or traffic lane from where the torches are to be used. This leaves the gas hose lying on the floor to be run over, cut and crushed by any of the numerous hand and electric trucks that travel this traffic lane each day. It is desirable to protect this hose in some manner, but more important to the welder is the elimination of the nuisance of having to stop in the middle of a job and repair a hose. This condition existed in one small New England shop and was allowed



Four of the welded A-frame supports for pipe and hose lines can be seen along erecting-shop aisle

to go until most of the hose lines in the shop were patched almost every two or three feet. Finally, a steel bridge was made to lay over the hose on the floor. This protected the hose but created a safety hazard because the plate was slippery to walk over and it made an uneven place for trucks to run over.

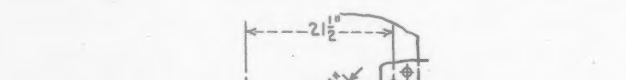
In this shop, on each of the columns bearing the gas stations there is also a water and steam outlet connection and these are piped across the runway when needed for filling and testing boilers and drying lagging. The pipe lines are put up and taken down as needed. The problem was solved satisfactorily by erecting a neat all-welded A-frame. Loops were made from ⅜-in. round iron and welded at 24-in. intervals along the top of the pipe making a place to lay the welding hose, thereby protecting it from the truck wheels and keeping it out of the way.

This method is now used for air hose, electric-light cords and city gas lines, and the floor is clear.

Pitted Area Repaired by Boiler Course Extension*

Pitted sheets are not uncommon in bad-water districts and the usual remedy is to apply new bottom half-course sheets if the pitting embraces a large area or a patch if the pitted area is small. Because of pits in the bottom of the second and third courses it was necessary to repair the boiler of a locomotive of the 2-8-8-2 type. In this boiler the pits in the second course were between the inside liner at the front boiler saddle location and the edge of the third course sheet. The pits in the third course were just ahead of the inside liner at the cylinder saddle.

* An entry in the prize competition on boiler patches announced in the March, 1939, issue. The names of the prize winners were published in the August, 1939, issue.



The application of the projection of the new second course to reinforce pitted area at the bottom of third course

The application of bottom half-course sheets was considered unsatisfactory as the longitudinal seams in both courses were diamond shaped and in combination with the inside bottom liners in these courses allowed for insufficient space for the two additional longitudinal seams required. Neither inside nor outside patches were practical due to the conditions imposed by the inside liners and the two saddles.

It was decided that the best method for making economical and satisfactory repairs to this boiler was to apply a new second course sheet with a projection extending over the outside of the third course to take care of the pitted area in that course. The illustration shows how this repair was made. While this is perhaps not a patch difficult to design or apply, it illustrates a boiler repair problem in which many conditions must be carefully considered in the drafting room.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Efficiency of Triple-Riveted Patch With Double Straps

Q.—What is the efficiency of a triple-riveted patch, with double straps, using 1-in. rivets, 8-in. pitch, 13/16-in. shell, with a tensile strength of 55,000 lb. per sq. in.? What effect does the length of the crack have on the efficiency?—D. E. D.

A.—The efficiency of a triple-riveted and double-strap patch as illustrated in the diagram should be computed in the same manner as for a triple-riveted and double-strap butt seam, as follows:

Where

TS = Tensile strength of plate, lb. per sq. in.
t = Thickness of plate, in.
b = Thickness of butt strap, in.
P = Pitch of rivets on row having greatest pitch, in.
d = Diameter of rivet after driving = diameter of rivet holes = 1 1/16 in.
a = Cross-sectional area of rivet after driving, sq. in.
s = Shearing strength of rivets in single shear = 44,000 lb. per sq. in.
S = Shearing strength of rivets in double shear = 88,000 lb. per sq. in.
c = Crushing strength of mild steel = 95,000 lb. per sq. in.
n = Number of rivets in single shear in a unit length of joint
N = Number of rivets in double shear in a unit length of joint

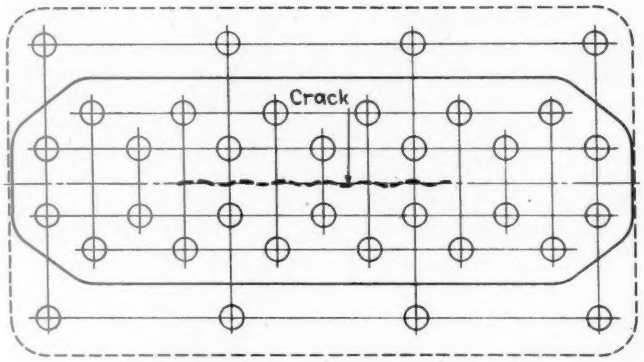
Then

A = Strength of solid plate $= P \times t \times TS = 8 \times .8125 \times 55{,}000 = 357{,}500$ lb.

B = Strength of plate between rivet holes in outer row $= (P - d) \times t \times TS = (8 - 1.0625)\ .8125 \times 55{,}000 = 310{,}019$ lb.

C = Shearing strength of four rivets in double shear, plus the shearing strength of one rivet in single shear $= N \times S \times a + n \times a \times s = 4 \times 88{,}000 \times .8866 + 1 \times 44{,}000 \times .8866 = 351{,}093$ lb.

D = Strength of plate between rivet holes in second row, plus the shearing strength of one rivet in single shear in the outer row $= (P - 2d)\ t \times TS + n \times s \times a = (8 - 2.125)\ .8125 \times 55{,}000 + 1 \times 44{,}000 \times .8866 = 301{,}549$ lb.



Triple-riveted patch with double straps

E = Strength of plate between rivet holes in the second row plus the crushing strength of butt strap in front of one rivet in outer row $= (P - 2d)\ t \times TS + d \times b \times c = (8 - 2.125)\ .8125 \times 55{,}000 + 1.0625 \times .8125 \times 95{,}000 = 344{,}550$ lb.

F = Crushing strength of plate in front of four rivets, plus the crushing strength of butt strap in front of one rivet $= N \times d \times t \times c + n \times d \times b \times c = 4 \times 1.0625 \times .8125 \times 95{,}000 + 1 \times 1.0625 \times .8125 \times 95{,}000 = 310{,}057$ lb.

G = Crushing strength of plate in front of four rivets, plus the shearing strength of one rivet in single shear $N \times d \times t \times c + n \times s \times a = 4 \times 1.0625 \times .8125 \times 95{,}000 + 1 \times 44{,}000 \times .8866 = 367{,}056$ lb.

Divide B, C, D, E, F or G (whichever is the least) by A and the quotient will be the efficiency of the patch. Efficiency of patch $= 301{,}549 \div 357{,}500 = 84.34$ per cent.

The length of the crack, when it is greater than the pitch of the outer row of rivets in the patch, would not affect the efficiency of the patch.

The length of the crack when it is less than the pitch of the outer row of rivets in the patch, would affect the above calculations in that the strength of the plate, i. e., (P—length of crack) $\times .8125 \times 55{,}000$ would be added to C, F and G, strengthening the patch at these points. However, it will be noted in the calculations that the weakest point of the seam is D, the strength of the plate between rivet holes in second row, plus the shearing strength of one rivet in single shear in the outer row. D would remain the weakest point of the seam as the strength of the solid plate remaining due to the length of the crack being less than P does not strengthen the patch at D.

Causes of Foaming in Boilers

Q—What are the causes of foaming in a locomotive boiler?—M. J. L.

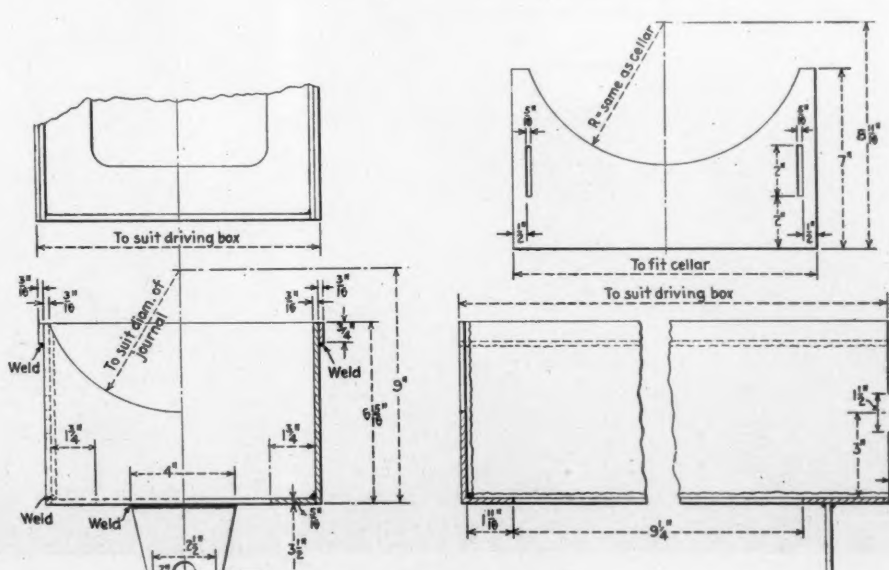
A.—The use of caustic soda and soda ash in the water treatment is one of the chief causes of foaming; oil and grease carried into the boiler is another. The latter gets in the boiler when the exhaust steam from the cylinders is mixed with the boiler feed water in the feedwater heater without proper oil separation or when the exhaust steam from the various auxiliaries is condensed back into the tank with no provision for oil separation.

The presence of suspended solids or sludge in the boiler water also causes foaming. The theory is that highly divided particles tend to collect in the surface film surrounding the steam bubble and make it tougher. Consequently, when the steam bubble reaches the surface of the water it does not break but remains intact and builds up foam. This theory suggests that the finer the particles, the greater their collection in the bubble.

All-Welded Steel Grease Cellars

Whether or not many of the cast-iron grease cellars that are removed from the boxes in a broken condition may have been broken by the carelessness of workmen, it remains a fact that a great many are broken. The welding foreman in a small back shop on an eastern road developed an all-welded grease cellar that has been applied to many locomotives on that road and given satisfactory service.

The manner in which the cellar is made is shown in the accompanying drawings. The several pieces of the cellar, i. e., sides, ends, bottom and reinforcing strips may be flame-cut if other equipment is not available. The joints between sides, end and bottom are welded. The slots in the separate end plate are so spaced that it will slip onto the lugs on the cellar without difficulty. Small S-hooks are used to hold the end plate in place. The lug that is welded onto the bottom of the cellar has a ⅞-in. hole that fits over a ¾-in. stud in the keeper plate to hold the cellar in position in the box.

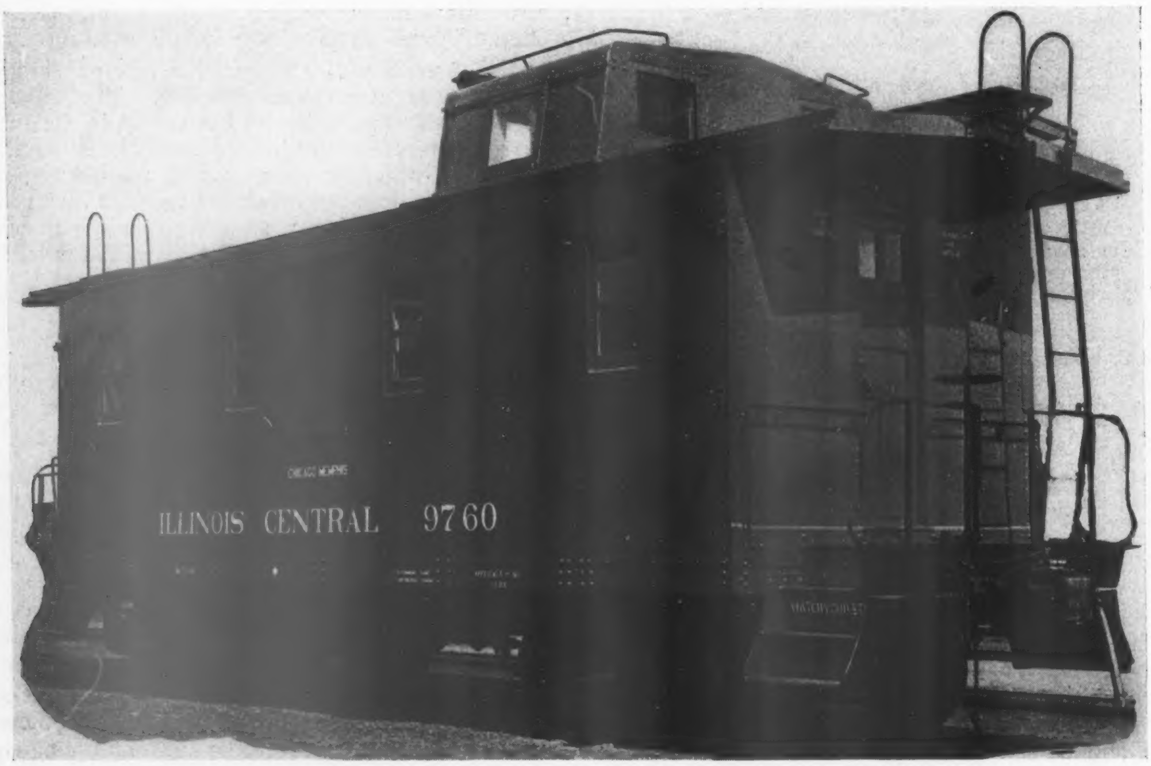


Details of an all-welded driving-box grease cellar

Illinois Central Builds 100 Steel Caboose Cars

The Illinois Central has recently completed the construction of 100 modern steel-sheathed caboose cars, built in the company shops, Centralia, Ill., from drawings and specifications drawn up by the railroad.

The steel underframes were constructed from reworked material, secured from a series of eight-door, drop-bottom gondolas which were retired from coal service some time ago, but showed little deterioration of the underframe parts. The superstructure, framing, sheathing and roof are copper-bearing steel, with combined riveted and welded framing members. The 14-gage roof sheets are applied transversely of the car, riveted to a vertical web of A-section side plates and edges butt-welded at the steel carlines. The roof sheets are of equal width with one exception, and roof carlines are so located as to provide two intermediate supports between roof



The completed steel-sheathed caboose

Interior of the steel car body before being insulated

Caboose interior ready for service

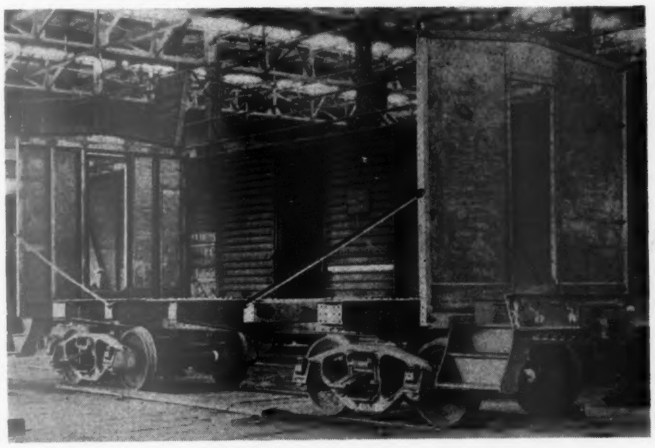
sheet joints, the roof sheets being spot-welded to these intermediate carlines.

The cupola framing and sheathing are a combined welded and riveted construction with cupola eaves rounded to present an improved appearance.

The inside surfaces of the side, end and roof sheets received one coat of rust preventative paint and one coat of plastic insulating and sound deadening material, applied ¼ in. thick. A 1½-in. layer of hairfelt insulation was then applied and secured in place by metal strips with self-tapping screws in framing members and wood screws in furring posts. The side and end walls and ceiling are lined with 13/16-in. by 5¼-in. tongue-and-groove long-leaf yellow pine.

The floor construction consists of a 1¾-in by 5¼-in. shiplap blind floor, laid transversely of the car and covered with a coat of car cement and layer of heavy waterproof paper. The 13/16-in. by 5¼-in. tongue-and-groove top flooring is laid lengthwise of the car. The platforms, steps and running boards are constructed of wood to the railroad's standard design.

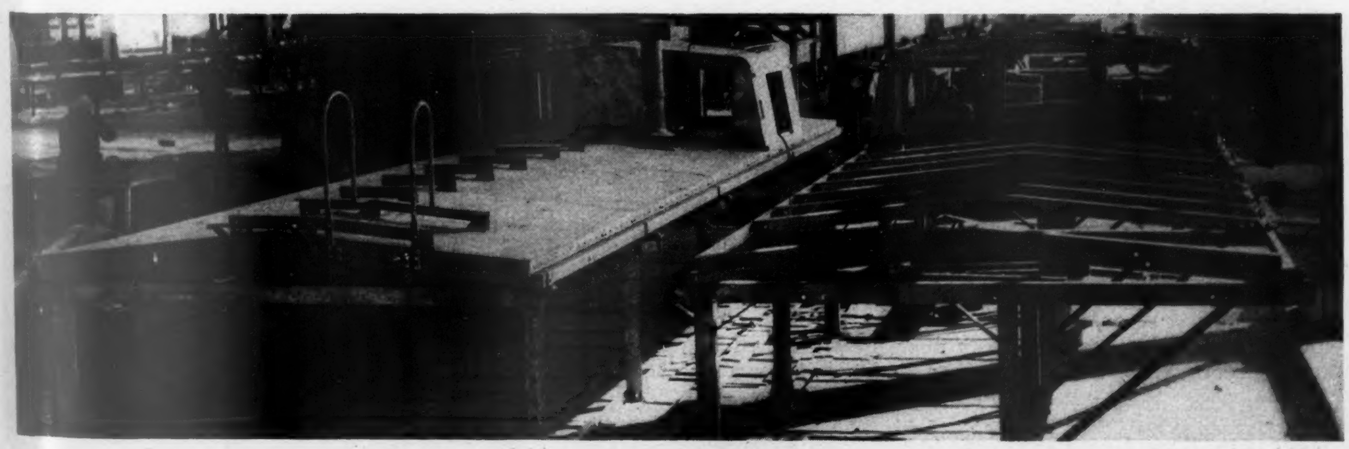
The interior fixtures include four bunks of steel construction, and the usual train crew accessories. Careful attention has been given to the safety feature in design-



Application of steel ends to the caboose underframe

Original underframe in the process of shortening

The shortened underframe mounted on caboose trucks



Fabrication of the caboose roof and cupola

ing interior fixtures, sharp projections being avoided and corners rounded wherever possible.

The cars are mounted on re-worked Bettendorf trucks, to which elliptic springs have been applied, and wheels were ground after mounting.

The accompanying illustrations show the new Illinois Central cabooses in various stages of construction. The general dimensions of the car are as follows: Length over strikers, 34 ft. $1\frac{1}{2}$ in.; length over body ends, 28 ft.; length inside, 27 ft. $3\frac{3}{16}$ in.; length between truck centers, 19 ft.; length over roof, 33 ft. 1 in.; width over cupola side running boards, 10 ft. $5\frac{1}{4}$ in.; width over side posts, 9 ft. 7 in.; and average light weight of car, 49,000 lb.

The Car Inspector

*By Leonard West**

Having been a lead car inspector for several years, and as a result closely associated with his activities during this time, naturally I feel that the car inspector must be the subject of my paper tonight. In my opinion, he with his exacting duties, authority, responsibilities, etc., is one of the most essential of railway employees.

Let's for the moment, define some of his duties. (1) An inspection of inbound trains and cuts with the view of sifting out and correcting conditions which render cars, both loaded and empty, unsafe for main line movement; (2) preparation of outbound trains for departure, including inspection and test of air brakes, closing of side doors, examination of journal boxes and a running inspection to prevent some defect getting away that might have occurred in yard handling; (3) inspection of cars received in interchange, including issuing of defect cards covering unfair usage damage as shown in the interchange rules; this is very important, and involves thousands of dollars annually; (4) miscellaneous inspections, such as classifying empty cars for certain commodities, interior inspection of different kinds of freight, inspection of open top loads for safety and compliance with the Mechanical Division loading rules, servicing of industries and many others too numerous to mention.

I believe you will agree that all car department employees do not make good car inspectors. In this case, approval of the applicant by supervisors is important, and serious thought should be given to his schooling, penmanship, ability to learn, general attitude toward the work, etc., before he is assigned to these duties. In all cases a new man, in my opinion, should be given reasonable time to break in. Trying to teach him interchange and loading rules, safety rules, air brake operation, etc., in too short a time, only confuses him and results in retarding his progress. Periodical examinations, either oral or written, are helpful to all car inspectors in solving their daily problems. I also believe that too frequently the importance of the car inspector to the railroads is overlooked in the desire for rapid movement of cars through terminals. He must be given sufficient time to do his work if we expect to get the desired results.

One of the best assets a car inspector can have is the ability to use good judgment when called upon to do so. Shopping a load for some minor defect results in unnecessary switching and needless delay. Failure to notify yard men when cars have defective safety appliances, the use of which might result in injury, is also bad. In many cases cars are shopped for wheel defects which are run off repair tracks without repairs because some one either failed to, or did not properly use the wheel gage with which he was provided. These are only some examples where the car inspector can save his company money and we should work toward the elimination of all such cases.

The average car inspector is familiar with the weak points of system equipment and can tell from experience on which class car the sills, body and truck bolsters, side frames, or other parts may be failing. This information should be passed along to supervisors who should see that those interested in car construction learn of it.

To emphasize the authority of a car inspector, one has only to realize that he is just about the only man on a railroad who can stop the forward movement of a car. He does this simply by marking it "Bad Order." Then too, in a terminal like St. Louis he carries in his possession the check books of all the railroads entering the terminal. All he has to do is write a defect card covering certain delivering line defects and the company against whom the card is issued must pay for the cost of repairs. These two reasons alone, in my opinion, justify careful selection of men, for these positions and close cooperation between supervisors and inspectors thereafter.

April has been designated as Perfect Shipping and Careful Handling Month. The car inspector can and will play an important part in this. Close and careful inspection of cars for commodity loading will help. Removal of protruding nails and screws to prevent tearing of sacks and cartons is also an important item, in fact the many things that he can do in this campaign are too numerous for recording here.

* Lead car inspector, Missouri Pacific, St. Louis, Mo. This discussion by Mr. West of the duties of a car inspector, submitted at the April meeting of the Car Department Association of St. Louis, was awarded a prize as the third best paper presented by a car man below the rank of general foreman during the year 1940.

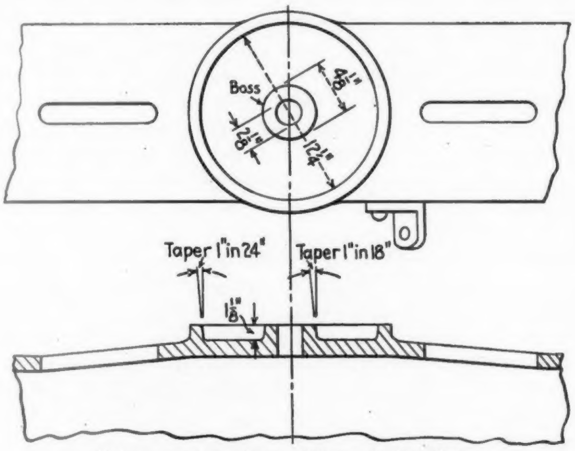
Re-Design of Center Plate Proposed

By W. C. Fox

Are center plates now in use a contributing factor in the derailments of freight cars? Would a new type of center plate which includes the center boss of the old style and the horizontal-bearing surface of the later type of plates, be an improvement? The boss in the center gives the proposed type, shown in the illustrations, a much smaller pivot point and reduces the friction between the vertical surfaces. It will be noted that the center boss takes all the horizontal friction. The outer vertical surfaces on the top and bottom center plates do not touch but they do act as a secondary defense. The center boss prevents the lubricant from being forced out through the king-pin hole in the bottom center plates as often happens with the present set-up when the car is lowered on the trucks. Vertical bearing surfaces would be changed to the inside and protected from dirt and grit and the loss of load-carrying bearing area in the bottom center plate would be very small.

It has been noted in repairing cars that the vertical

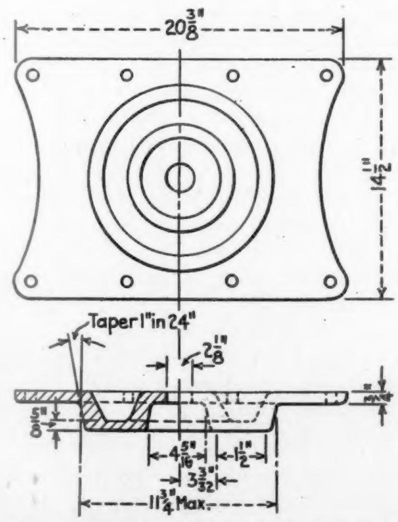
outside edge of the present top center plate, where it rubs on the vertical inside edge of the bottom center plate, shows scars where it has been cut and scored when the two faces rub together as the truck turns in taking a



Bolster center plate with re-designed boss

curve. The vertical flanges on the present bottom center plate act as a brake band on the edge of the top center plate; the larger the center plate, the greater the braking friction and the harder it is to swing the truck to follow the track curves.

The increased train resistance on a curve is caused by flange friction and wheel slippage. This additional resistance must be offset by increased drawbar pull at the engine; the engine trying to pull each car directly and in a straight line while the wheel flanges try to hold the car on the rails and make it take the indirect and longer route. The point of contact between the car body which is being pulled, and the wheels which guide the car, is the center plates. Therefore, the friction between the vertical portions of the upper and lower center plates must be very great in the front end or in the middle of a long train of cars on a curve. It is difficult for the wheels on the front cars to line up the truck with the straight track after the curve is passed, as the pull of the cars following is holding the vertical edges of the center



Changes in top center plate to accommodate re-designed bolster

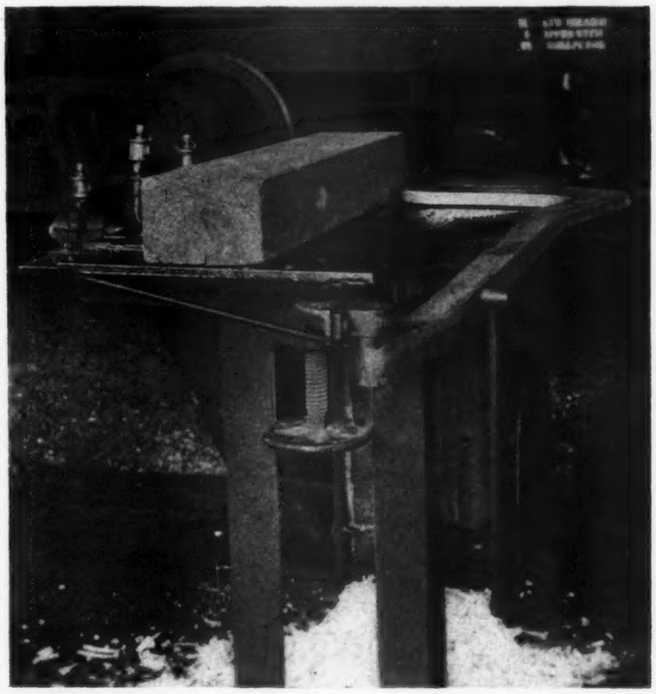
plates tight together on the inside of the curve. If the curve is on an ascending grade and the speed is slow, there will be no centrifugal force to throw the cars to the outside of the track and the flanges on the inside will take all the strain.

Two Woodworking Machine Guards

Two different types of woodworking-machine guards which are not especially new but possess a number of important advantages over the saw and cutter guards generally used in railway-shop mill rooms are shown in two illustrations.

The ripping cut-off saw guard shown in the first view is supplied by the Oliver Machine Company, St. Louis, Mo. It is applied to a saw table made locally. The saw is 22 in. in diameter, and is belt-driven from an electric motor of suitable size mounted in the base and operating on 440-volt, 25-cycle electric current. The saw is equipped with sight oil feed to the main bearings and a start-and-stop electric push button, located as shown in the upper part of the illustration. It is used primarily in sawing 6-in. by 8-in. cradle blocks.

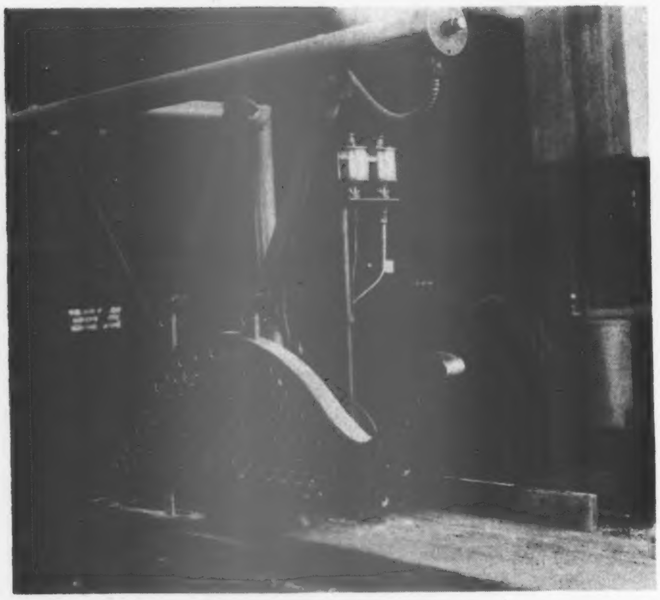
The perforated sheet-metal guard is supported by means of a pantagraph arrangement from an overhead



Cradle-block shaper which mills to a 42-in. radius—It also has an effective cutter guard

pipe frame bolted to the machine, a long, light coil spring counterbalancing enough of the weight so that very little pressure on the end of a board or plank is required to raise the guard just enough to enable the lumber to be sawed to the required width. The particular advantage of this guard, aside from the important safety feature, is the fact that it can be used for cross cuts owing to the method of suspension employed. The table also is capable of being tilted, which adds to the flexibility of this type of machine.

The cradle-block shaper, shown in the second illustration, is driven by a 2-hp. electric motor, also operating on 440-volt, 25-cycle current. The cutter knives are ground so as to machine the proper radius on cradle blocks for 8,000 and 10,000-gal. tanks. The machine is belt driven and a cutter adjustable to give the desired depth of cut. The horizontally swinging cutter guard, shown at the right in the illustration, normally covers the knives and moves off them under spring tension as the wood passes through, then immediately returning to



Shop-made ripping cut-off saw equipped with an unusually effective saw guard

the guard position. This method of milling cradle blocks quickly and accurately to the desired radius of about 42 in. is much more satisfactory than attempting to cut them out with any hand tools.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

642—*Q.—What brake-cylinder pressure is obtained from an emergency brake application from 110 lb. brake-pipe pressure with the A-4-A relay valve?* A.—Approximately 57 lb.

643—*Q.—What braking ratio will this brake-cylinder pressure develop?* A.—With the brake rigging arranged for 250 per cent braking ratio, the maximum braking ratio developed by the A-4-A relay valve from an emergency brake application is the same (150 per cent) as that developed by the Type B relay valve, or the universal valve.

644—*Q.—For what reason is 150 per cent braking ratio used with the D-22-A control valve equipment?* A.—In order to obtain harmonious brake operation when cars having control-valve brake equipment are associated with cars having the standard passenger-car equipment.

645—*Q.—What does a blow at the relay-valve exhaust port with the brake released indicate?* A.—A leak past the application valve of the relay valve.

646—*Q.—What does a blow at the relay valve with the brake applied indicate?* A.—A leak past the exhaust valve of the relay valve.

647—*Q.—How does leakage at the relay-valve exhaust affect the brake cylinder pressure?* A.—With the displacement reservoir and piping tight, brake cylinder pressure is automatically maintained against leakage by the operation of the relay valve self-lapping unit.

648—*Q.—Does variation in the brake-cylinder piston travel affect the amount of brake-cylinder pressure obtained from any given brake-pipe reduction?* A.—As the volume of the displacement reservoir does not vary and the brake-cylinder pressure is determined by the pressure in the displacement reservoir, variation of the brake-cylinder piston travel does not affect the brake-cylinder pressure development.

649—*Q.—What is indicated by leakage from the exhaust ports of the D-22-A control valve in release position?* A.—Leakage from the quick-service exhaust indicates leakage past the service graduating valve, service slide valve or service-portion cover gasket. Leakage from the displacement reservoir exhaust (pressure-retaining valve), indicates leakage past the service slide valve, release slide valve or service-portion body gasket. Leakage from the emergency portion exhaust indicates leakage past the vent valve, emergency slide valve, emergency graduating valve or emergency-portion body gasket.

650—*Q.—What is indicated by leakage from the exhaust ports of the D-22-A control valve in service lap position?* A.—Leakage from the quick-service exhaust indicates leakage past the service slide valve or service-portion cover gasket. Leakage from the displacement reservoir exhaust (pressure-retaining valve) indicates leakage past the release slide valve, service-portion body gasket or supply-valve charging checks *74* and *87*. Leakage from the emergency-portion exhaust indicates the same leakage as in release position.

651—*Q.—What is indicated by leakage from the exhaust ports of the D-22-A control valve in emergency position?* A.—Leakage from the quick-service exhaust indicates leakage past the service slide valve or service-portion cover gasket. Leakage from the displacement-reservoir exhaust (pressure retaining valve) indicates the same leakage as in the service lap position. Leakage from the emergency-portion exhaust indicates leakage past the emergency slide valve, emergency-valve seal or emergency-portion body gasket.

652—*Q.—What should be done if leakage is experienced with the control valve equipment?* A.—If leakage is excessive or interferes with the normal operation of the equipment, proper report should be made which will insure correct repairs or replacement of defective portions with those known to be in good order.

653—*Q.—Does leakage at the exhaust ports of the control valve justify attempt to make repairs at the car to which the valve is attached.* A.—The exact location of the leakage can only be determined by prescribed test on an approved test rack. In any event, to dismantle a valve on the car is not permissible because of possible damage due to dirt or improper handling of parts.

654—*Q.—When attaching an uncharged car having D-22-A control valve equipment to a train, how much time should be allowed for charging before a brake test is made?* A.—Approximately 10 minutes.

655—*Q.—After an emergency brake application, how much time should be allowed before attempt is made to release?* A.—Approximately 20 seconds.

656—*Q.—Why is it necessary to wait this time?* A.—Because the vent valve on each control valve remains open approximately 20 seconds, making large direct openings from the brake pipe to the atmosphere, therefore, the brake-pipe pressure can not be restored to release the brakes in less than the time required for the vent valve to close.

* * *

Photo by C. F. H. Allen

D. L. & W. locomotive No. 1628 going up grade at Danville, N. Y.

(*Turn to next left-hand page*)

High Spots in

Railway Affairs . . .

Beating the Blitzkrieg

Press advertisements and posters of the British railways tell something of the spirit in which the railways and the public are co-operating to meet the wartime emergencies. One advertisement, under the caption, "What Station Is This," includes the following statement. "Station names are now in small letters. If you can't see the name and can't hear the porter's voice, ask another traveler. It is dangerous to raise the blind and to make the train a target for bombers. If you know where you are by local signs and sounds, please tell others in your carriage. We will beat the blitzkrieg by helping one another."

Traffic for The First Quarter

According to estimates made by the thirteen Shippers Advisory Boards, freight car loadings in the first quarter of 1941 are expected to exceed those for the same period last year by 9.5 per cent. As is to be expected, because of the war conditions abroad and our own national defense program, the heavy goods industries will make the largest contribution to this increased traffic. Those commodities which are expected to show the greatest increases are iron and steel, 34.9 per cent; brick and clay products, 30 per cent; machinery and boilers, 27.9 per cent; gravel, sand and stone, 22.9 per cent; lumber and forest products, 19.8 per cent; ore and concentrates, 16.4 per cent; chemicals and explosives, 16.2 per cent; and automobiles, trucks and parts, 15.7 per cent.

Competition for Passenger Traffic

The great bulk of the inter-city passenger traffic by public and private carriers is handled on the highways, and largely by private automobiles. The Interstate Commerce Commission, in its recent report, estimates that during the calendar year of 1939 private automobiles accounted for 85.44 per cent of the inter-city traffic on a passenger-mile basis. The railways handled only 8.62 per cent, buses 5.15 per cent, water carriers 0.54 per cent and the air carriers 0.25 per cent. The picture changes radically if private automobiles are excluded and only commercial carriers are considered. On that basis the railroads in 1939 handled 59.17 per cent of the commercial passenger-miles, the buses 35.42 per cent, inland waterways 3.71 per cent and airways 1.70 per cent. The report also points out that "travel by air is competitive with sleeping and parlor car service by rail and hence it is significant that the ratio of revenue passenger-miles by air to passenger-miles in sleeping and parlor cars was 6.5 per cent for 1938, 9.0 per cent for 1939, and 12.7 per cent for the first half of 1940."

St. Lawrence Seaway Crops Up Again

President Roosevelt, on the plea of national defense, has again dragged out the St. Lawrence Seaway project. The fallacy of this argument was clearly exposed by Judge R. V. Fletcher, general counsel, Association of American Railroads, at a meeting of the Atlantic States Shippers Advisory Board in New York, on January 9. He pointed out that since the navigation channel cannot be completed in less than eight years from the time the actual construction begins, it will be of no service in the present war emergency. He also said that the 27-ft. channel contemplated would bar from passage, when fully loaded, 54 per cent of the world's vessels, representing 70 per cent of its tonnage and including all war vessels of capital proportions. Moreover, the seaway cannot be used for more than seven months of the year because of ice, and 16 days would be required to make the round trip from Montreal, Que., to Duluth, Minn. With long range aerial fighters and bombers, a shipyard located at Cleveland would hardly be more immune from attack than one located at Chester, Pa. Speaking of sabotage he pointed out that one bomb from the air, or one charge of dynamite placed by a fifth columnist, might put the canal out of business indefinitely. Finally, he declared that "very competent authorities reach the conclusion that the total costs will reach the sum of $1,200,000,000, a huge sum of money subtracted from amounts which would otherwise be available for national defense."

I.C.C. and National Defense

In discussing transportation and national defense in its fifty-fourth annual report, the Interstate Commerce Commission says, "There has been considerable debate as to whether the railroads are taking adequate steps to expand their supply of cars and locomotives to meet the needs which may be expected." It points out that because of the sharp decline of traffic during the past decade, the number of freight cars retired by Class I railroads every year, from 1929 to 1939, exceeded the additions. This has caused concern in some quarters, but the Commission points out "that the railroads are now able, because of improved methods and conditions of operation, to do materially more work per unit of equipment than was the case when they had a greater supply." It points out also that the capacity of other forms of transportation has greatly increased. While the Commission believes that the question is a serious one and of vital importance in the defense program, it realizes that Ralph Budd, a member of the Advisory Commission of the Council of National Defense and president of the Chicago, Burlington & Quincy, and his consultants recognize the imporance of the problem and "are considering it from every angle. They have the means," says the Commission report, "which are much better than any that we have at our command, of appraising the transportation needs which are likely to arise and also the facilities which are available or should be available to meet those needs."

Railroad's Share Of Freight Traffic

In its recent annual report the Interstate Commerce Commission attempted to compare the relative importance of different types of carriers. It admits that this comparison involved "broad estimates which may be subject to a considerable margin of error." It was impractical to attempt to make estimates for 1940, and so the figures show a comparison between the years 1938 and 1939. On the basis of estimated ton-miles, all of the types of transportation showed a considerable increase. Total ton-mileage in 1939 was estimated as 543,375 millions, as compared to 460,689 millions in 1938, or roughly, an increase of about 18 per cent. In the distribution of the increased traffic, however, the highway carriers and the inland waterways made a somewhat better showing on a percentage basis than did the railways and the pipe lines. On a ton-mileage basis the railroads had 61.85 per cent of the total traffic in 1939, as compared to 63.49 per cent in 1938. The inland waterways, including the Great Lakes, had 17.71 per cent in 1939, compared to 14.49 per cent in 1938. The pipe lines' percentage of the total decreased from 13.99 in 1938 to 11.97 in 1939. On the other hand, the highway traffic increased from 8.03 in 1938 to 8.47 in 1939. The ton-miles of air mail and express was less than .01 per cent of the total. The improved position of the inland waterways was due largely to the iron ore traffic on the Great Lakes.

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Photo Courtesy Southern Pacific Company

NEWS

Mile-A-Minute Runs—63,447 Miles of Them

SEPARATE passenger runs in the United States and Canada operating daily at an average speed of a mile-a-minute or more grew during 1940 from 997 to 1,226—a jump of 23 per cent—according to an annual train schedule survey recently completed and made public by "Railroad Magazine." The total mileage covered by these fast trains also increased from 54,956 to 63,447, or 15½ per cent. By including the records of trans-continental streamliners that operate only on certain days, the current figures total 1,294 runs and 73,165 miles as compared with 1,070 runs and 65,034 miles at the end of 1939.

The extension of mile-a-minute railroading, it is pointed out, is primarily due to the general improvement of inter-city services rather than to a spectacular speed-up on any one system. Since the first of 1940, the tabulation discloses, 11 runs were added to those listed at speeds of 70 m. p. h. and more, bringing the total number to 96. These fast trains cover an aggregate distance of 7,387 miles, all but 2,156 of which are booked daily.

Railroad Magazine's first survey of North American passenger train schedules was conducted in 1936, when there were 579 separate daily runs at an average speed of 60 m. p. h. and better, with a combined mileage of 29,301. This indicates that the mile-a-minute performances of American and Canadian passenger trains have more than doubled in four years.

Locomotive and Car Supply Adequate Pelley Believes

"RAILROADS of the United States enter 1941 with a plant that is geared to meet any transportation demand that may be made of them," said J. J. Pelley, president of the Association of American Railroads in a year-end statement summarizing the performance of the railroads in 1940. He added that "not only is car and motive power supply adequate on the basis of traffic now anticipated, but the railroads are being operated at new high efficiency levels"; and "at the same time new equipment is being added as traffic demands or replacements of obsolete equipment may require."

Mr. Pelley's statement continued as follows:

"In the current year the railroads installed in service 65,000 new freight cars and 400 locomotives and have 30,000 freight cars and 180 locomotives under construction. Since June 1, 1939, the number of freight cars in need of repairs has been cut in half. As a result, the number of freight cars in need of repair is now less than it has been at any time back to 1920.

"Based on conservative estimates, which take into consideration new freight cars actually put in service or under construction as well as those undergoing heavy repairs, the railroads will have at least 160,000 more freight cars available this coming fall than they had two years ago. Car-buying, however, is a continuing program and unquestionably there will be a still further increase in such cars by next October. On the basis of utilization obtained from freight equipment in the past, those 160,000 cars will handle 100,000 carloads per week, or 5,200,000 carloads per year, which is equivalent to one-seventh of the total number of carloadings handled in 1940.

"From the standpoint of operating efficiency, railroad performance was never better than in 1940.

"Railroads in 1940 hauled an average of 850 tons of freight per train, the highest on record and an increase of approximately 30 per cent compared with 1921. The average number of freight cars per train has increased from 37.4 cars in 1921 to 49.7 cars in 1940, or 33 per cent. Performance per train has doubled within that period. That is, the gross ton-miles per train hour increased from 16,555 in 1921, to 33,856 in 1940 while the net ton-miles per freight train hour increased from 7,506 in 1921 to 14,060 in 1940. In both instances, these are new high records. For each pound of fuel used in freight service in 1940 the railroads hauled nine tons of freight and equipment one mile compared with 6⅛ tons in 1921.

"Railroads enter 1941 with a level in freight traffic approximately seven per cent above one year ago. While it is still too early to forecast very definitely the trend of traffic in the coming year, the present expectation is that it will run from seven to ten per cent above 1940. Loading of revenue freight in 1940 totaled 36,350,000 carloads, an increase of 2,500,000 or 7.2 per cent above 1939 and nearly 6,000,000 or 19.3 per cent above 1938, but a decrease of 9,500,000 or 20.8 per cent below 1930. On the basis of revenue ton-miles (the number of tons of revenue freight multiplied by the distance carried) freight traffic in 1940 amounted to 370 billion, an increase of 11 per cent above 1939.

"Passenger travel in the past 12 months amounted to 23,700,000,000 passenger miles (the number of passengers multiplied by the distance traveled), an increase of 4.6 per cent compared with 1939 and an increase of 9.6 per cent compared with 1938. Passenger rates were lower in 1940 than in any preceding year, the average revenue per passenger mile having been 1.75 cents compared with 1.84 cents in 1939.

"While complete reports are not available, the Class I railroads in 1940 are expected to have a net railway operating income before fixed charges of $650,000,000, or a return of 2.49 per cent on their property investment. . . . After fixed charges the Class I railroads, according to estimates, will have a net income in 1940 of $155,000,000 compared with $93,000,000 in 1939.

"Maintenance expenditures of Class I railroads in 1940 totaled $1,317,000,000 compared with $1,233,000,000 in 1939. Of the total of 1940, expenditures for maintenance of equipment amounted to $817,000,000 and for maintenance of way and structures, the amount was $500,000,000.

"Expenditures for fuel, supplies and materials used in current operation by the Class I railroads amounted to approximately $850,000,000 in 1940 compared with $769,000,000 in 1939, and $583,000,000 in 1938.

"Capital expenditures in 1940 for equipment, roadway and structures and other improvements to property are estimated at $400,000,000, compared with $262,000,000 in the preceding year. This can be contrasted with $794,000,000, the average annual capital expenditure from 1927 to 1930.

"The increase in traffic as well as large expenditures for maintenance work resulted in a further increase in employment on the railroads in the past year, the average number of employees having been 1,026,000, or an increase of 3.9 per cent compared with the preceding year. Average annual earnings per employee in 1940 was $1,900 compared with $1,886 in 1939.

Orders and Inquiries for New Equipment Placed Since the Closing of the January Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Locos.	Builder
American Steel & Wire Co.	1	660-hp. Diesel-elec.	American Loco. Co.
	1	660-hp. Diesel-elec.	Baldwin Loco. Wks.
Atchison, Topeka & Santa Fe	1	360-hp. Diesel-elec.	Davenport Besler Corp.
	1	360-hp. Diesel-elec.	Whitcomb Loco. Wks.
Birmingham Southern	1	1,000-hp. Diesel-elec.	American Loco. Co.
Canadian Car & Munitions, Ltd.	2	300-hp. Diesel-elec.	General Electric Co.
Central of Georgia	2	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	1,000-hp. Diesel-elec.	
	1	1,000-hp. Diesel-elec.	American Loco. Co.
	1	660-hp. Diesel-elec.	
Charles City Western	1	150-hp. Diesel-elec.	General Elec. Co.
Inland Steel Co.	1	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	660-hp. Diesel-elec.	American Loco. Co.
Lone Star Cement Corp.	1	175-hp. Diesel-elec.	Vulcan Iron Works
Messena Terminal	1	660-hp. Diesel-elec.	American Loco. Co.
Newburgh & South Shore	2	660-hp. Diesel-elec.	American Loco. Co.
New York Central	1	600-hp. Diesel-elec.	Baldwin Loco. Wks.
	26	600-hp. Diesel-elec.	Electro-Motive Corp.
	9	660-hp. Diesel-elec.	American Loco. Co.

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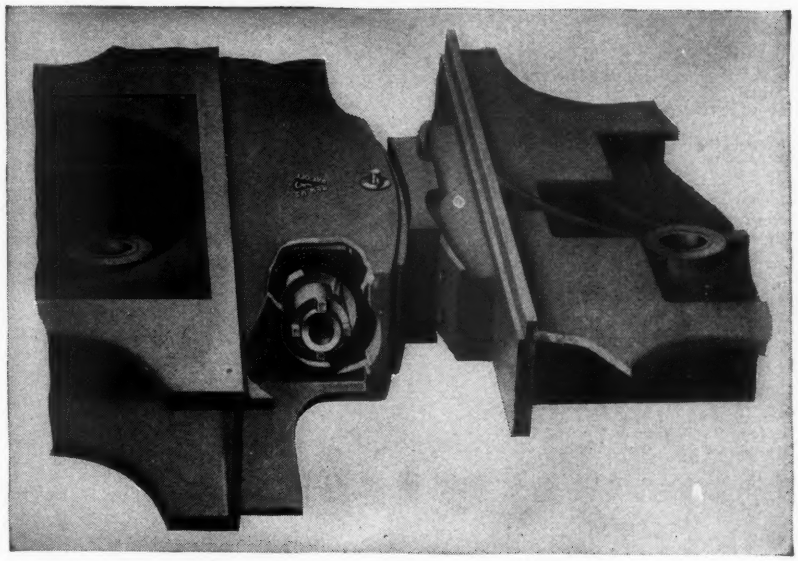
ESSENTIAL TO
HIGH SPEED
OPERATION
OF MODERN
LOCOMOTIVES



Patapsco & Black Rivers	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Pennsylvania	20[1]	21,000-gal. loco. tenders	Company shops
Philadelphia, Bethlehem & New England	2	600-hp. Diesel-elec.	Electro-Motive Corp.
River Terminal	1	660-hp. Diesel-elec.	American Loco. Co.
Sanderson & Porter Co.	2	300-hp. Diesel-elec.	General Electric Co.
Sao Paulo-Parana R. R. of Brazil	1	2-8-2	Baldwin Loco. Wks.
Seaboard Air Line	1	660-hp. Diesel-elec.	American Loco. Co.
	1	660-hp. Diesel-elec.	Baldwin Loco. Wks.
South Buffalo	3	660-hp. Diesel-elec.	American Loco. Co.
Texas Pacific-Missouri Pacific Terminal	1	660-hp. Diesel-elec.	American Loco. Co.
Union Pacific	15	4-8-8-4	American Loco. Co.
	10	1,000-hp. Diesel-elec.	Electro-Motive Corp.
United Fruit Co.	4[2]	2-8-2	Baldwin Loco. Wks.
Youngstown & Northern	1	1,000-hp. Diesel-elec.	American Loco. Co.

LOCOMOTIVE INQUIRIES

Denver & Rio Grande Western	5-10	4-6-6-4	....
Missouri Pacific	2[3]	1,000-hp. Diesel-elec.	....
	5[3]	600-hp. Diesel-elec.	....
	11[3]	44-ton Diesel-elec.	....
New York, New Haven & Hartford	10	600-hp. Diesel-elec.	....

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Cars	Builder
Western Rwy. of Alabama			
Chicago, Burlington & Quincy	250	70-ton ballast	American Car & Fdry. Co.
Carnegie-Illinois Steel Co.	8	100-ton flat	Pressed Steel Car Co.
	1	Flat	Greenville Steel Car Co.
Duluth, Missabe & Iron Range	100	50-ton gondola	American Car & Fdry. Co.
Elgin, Joliet & Eastern	250	Hopper	Ralston Steel Car Co.
	350	Gondola	Gen. Amer. Transp. Corp.
	150	Gondola	Mt. Vernon Car Mfg. Co.
	200	Box	
	300	Box	American Car & Fdry. Co.
Illinois Central	115	70-ton gondola	Gen. Amer. Transp. Corp.
Litchfield & Madison	50	50-ton hopper	American Car & Fdry. Co.
	50	50-ton hopper	Gen. Amer. Transp. Corp.
New York Central	1,000[4]	55-ton box	Pressed Steel Car Co.
Northern Pacific	1,000	50-ton box	American Car & Fdry. Co.
	300	50-ton hopper	
	200	70-ton ballast	
	900	50-ton box	Pull.-Std. Car Mfg. Co.
	100	50-ton box	Company shops
Pennsylvania	2,000[1]	50-ton box	Company shops
	2,500[1]	70-ton gondola	
	600[1]	Bulk container	
	200	Cabooses	
Pennsylvania Salt Mfg. Co.	6	Tank	American Car & Fdry. Co.
	2	Tank	
Russian Government	100	Air-dump	Pressed Steel Car Co.
Union Pacific	250	50-ton auto-box	Company shops
	2,000	50-ton box	
Utah Copper Co.	100	100-ton ore	Pressed Steel Car Co.
	15	Air-dump	
Wabash	5	70-ton hopper	American Car & Fdry. Co.
Warren Petroleum Co.	30[2]	11,000-gal. tank	American Car & Fdry. Co.
	10[2]	10,500-gal. tank	

FREIGHT-CAR INQUIRIES

Chicago & North Western	1,000	Gondolas	....
	200	Ore	....
	500	Box	....
Lake Superior & Ishpeming	100	50-ton ore	....
Missouri Pacific[3]	1,200	55-ton hopper	....
	100	50-ton auto box	....
	2	Well-type	....
	70	70-ton cement	....
	2	Depressed center flat	....
South African Rwys. & Harbors	1,000	Gondola	....
Tennessee Coal, Iron & R. R. Co.	90	70-ton ore	....
	20	70-ton flat	....
	6	70-ton slab side hot hole	....
Union Pacific	300	Flat	....
	50	Mill-type gondola	....
Virginian	100	50-ton hopper	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Cars	Builder
Atlanta & West Point	2[2]	Baggage-express	American Car & Fdry. Co.
New York Central	45[5]	Coaches	Pull.-Std. Car Mfg. Co.
	25[5]	Coaches	American Car & Fdry. Co.
	25[5]	Coaches	Pressed Steel Car Co.

PASSENGER-CAR INQUIRIES

Missouri Pacific	1[3]	Rail-motor	....
	2[3]	Trains	....

[1] Orders let to the shops of the Pennsylvania for the locomotive tenders and freight cars reported here, for the remodeling and air conditioning of 80 passenger coaches, and for the purchase of five electric passenger locomotives, total $17,500,000.

[2] Delivery received.

[3] Permission received from the district court to secure competitive bids for this equipment. The locomotives, freight cars, and rail motor car will be for use on the Missouri Pacific and its subsidiaries. Each of the two streamline trains will consist of a 4,000-hp. Diesel-electric locomotive, a combination mail and baggage car, two coaches, a combination diner and lounge car, a baggage-express car, and a mail storage car.

[4] For service on the Pittsburgh & Lake Erie.

[5] The 95 coaches, to cost approximately $5,000,000, will be air conditioned, of all-steel construction, 80 ft. 6 in. in length, and will seat 56 passengers. They will have adjustable reclining chairs, brilliant lighting and unusually large washrooms. Deliveries are expected to begin about June.

I. C. Rail Cars—A Correction

THE buffet equipment on the new Illinois Central rail motor cars operating between Chicago and Champaign, Ill., and between Jackson, Miss., and New Orleans, La., respectively, was furnished by The Stearnes Co., Chicago, and not by Angelo Colonna as stated on page 12 of the January *Railway Mechanical Engineer.*

Equipment Purchasing and Modernization Programs

The Baltimore & Ohio has awarded a contract to the George F. Hazlewood Company, Cumberland, Md., for the construction of an extension to the company's enginehouse at Cumberland, Md., at an estimated cost of $50,000.

The Chicago & North Western is considering the purchase of a Diesel-electric, lightweight streamlined train for operation between Chicago and Green Bay, Wis., a distance of 199.7 miles.

The Norfolk Southern has asked the Interstate Commerce Commission to approve a plan whereby it would issue and sell to the Reconstruction Finance Corporation $938,000 of its three per cent serial equipment trust certificates maturing in 30 semiannual installments beginning August 1, 1941, and maturing in the amount of $32,000 on that date, and $32,000 on each February 1 and August 1, thereafter to and including February 1, 1945, and $31,000 on August 1, 1945, and $31,000 on each February 1 and August 1 thereafter to and including February 1, 1956. The proceeds will be used as part payment for new equipment costing $946,000 and consisting of 250 40-ton A. A. R. 4-C-40, steel-sheathed, wood-lined box cars; 50 50-ton all-steel gondola cars, and 50 50-ton hopper coal cars. Orders for this equipment were announced in the January issue.

The Seaboard Air Line has asked the Interstate Commerce Commission to approve a plan whereby it would issue and sell to the Reconstruction Finance Corporation $1,905,000 of three per cent serial equipment trust certificates, maturing in 15 equal annual installments beginning January 1, 1942. The proceeds will be used as part payment for new equipment costing a total of $2,159,700 and consisting of two 660-h.p. Diesel-electric switching locomotives, 500 new 50-ton, all-steel, double sheathed box cars, with wood lining, and 200 new 70-ton all-steel hopper cars.

The Union Pacific has asked the Interstate Commerce Commission for authority to assume liability for $12,570,000 of 1½ per cent equipment trust certificates, maturing in equal annual installments of $838,000 on January 1 in each of the years from 1942 to 1956, inclusive. The proceeds will be used as part payment for new equipment costing a total of $15,712,500 and consisting of 2,000 lightweight steel box cars with wood lining, 250 50-ft. automobile cars, 1,000 steel ballast cars, 15 4-8-8-4 type locomotives with tenders, 300 52-ft. 8½-in. flat cars, and 50 65-ft. low-side, mill type gondola cars. The company's petition states that the 2,000 box cars and the 250 automobile cars will be constructed in its own shops. Orders for the 15 locomotives and some of the freight equipment are announced in this issue.

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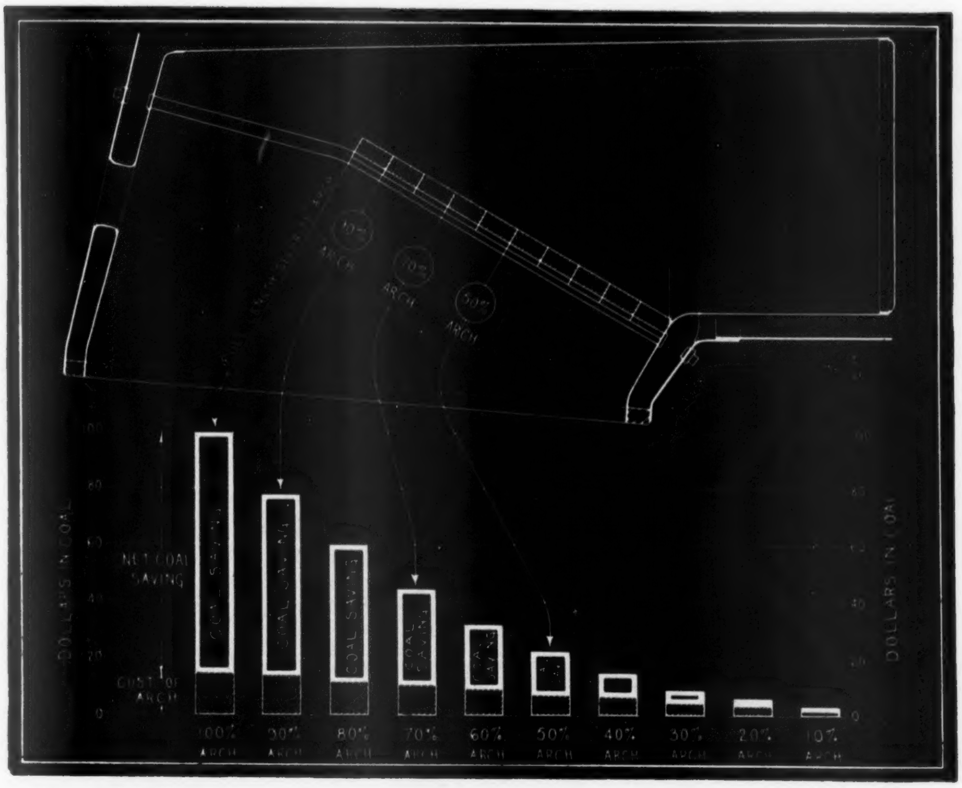

THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

Supply Trade Notes

Bruce M. Jones has been appointed sales engineer of the Buffalo Brake Beam Company with headquarters in New York.

Alex S. Anderson has been appointed district manager for the midwestern territory of the Duff-Norton Manufacturing Company, with headquarters at Chicago.

George L. Cotter has been appointed commercial engineer of the Westinghouse Air Brake Company, with headquarters at the general office in Wilmerding, Pa.

Ernest A. Flinn has been appointed sales representative of the Gustin-Bacon Manufacturing Company, Kansas City, Mo., with headquarters at New York.

Cooper-Bessemer Corp.—*C. B. Jahnke,* formerly vice-president and general manager of the Cooper-Bessemer Corporation has been elected president to succeed *B. B. Williams,* who has become chairman of the board. *E. J. Fithian,* former chairman, has resigned but will continue as a director.

John L. Hoffman has been appointed sales representative for The Oxweld Railroad Service Company in Southeastern territory, succeeding W. M. Leighton, retired. Mr. Hoffman has been actively engaged in the promotion of oxy-acetylene welding and cutting for twenty-two years. He started in business with Taylor-Wharton Iron &

John L. Hoffman

Steel Co., later joining the Central of New Jersey at its Elizabethport (N. J.) shops, working on welding projects in connection with locomotives. In 1922 he took a position as welding instructor with The Oxweld Railroad Service Company, Mechanical department, and worked for this company on a number of railroads in New England. Mr. Hoffman was made district superintendent for the New England territory in 1926 and had under his charge the mechanical and maintenance-of-way department's welding activities and instructors. Since 1936 he has been assistant general superintendent, with headquarters in Chicago.

M. C. Bellamy, sales engineer for the Timken Roller Bearing Company at Seattle, Wash., has been promoted to district manager of industrial bearing and steel sales for the Seattle territory. Mr. Bellamy graduated from Purdue University and spent several years in other industrial work before joining The Timken Roller Bearing Company in 1928. After working in the plant and engineering department for two years, he was appointed sales engineer in 1930.

Robert E. Frame, sales manager of the Standard Car Truck Company, Chicago, has been elected vice-president. Mr. Frame was born in Chicago on August 28, 1877, and received his education in the public schools of Chicago. He enlisted in the United States Army during the Spanish War and in 1900 entered the employ of

Robert E. Frame

the Pullman Company. He resigned as freight-car estimator in September, 1904, to accept a similar position with the American Car and Foundry Company at St. Louis, Mo. By 1909 he had progressed to the position of mechanical superintendent, with supervision over the drafting and estimating departments. He was then promoted to sales engineer at Chicago. In 1912 he resigned to become assistant to the president of the Haskell & Barker Car Company, Michigan City, Ind. Mr. Frame resigned from the Pullman Car and Manufacturing Company (successors to Haskell & Barker Car Company), in September, 1923, to enter the brake-shoe business as one of the founders of the Central Brake Shoe & Foundry Company. Six years later this company was absorbed by the American Brake Shoe & Foundry Company and Mr. Frame became associated with the Standard Car Truck Company. In 1934 he was appointed sales manager.

Grip Nut Company.—The sales and general offices of the Grip Nut Company have been moved from South Whitley, Ind., to 310 S. Michigan avenue, Chicago, at which address the company has maintained an executive office for a number of years.

C. N. Thulin, vice-president of the Duff-Norton Manufacturing Company, with headquarters at Chicago, has resigned to become manager of railway sales of the Joyce-Cridland Company, Dayton, Ohio.

Mr. Thulin entered railway service with the Northern Pacific in 1886 and resigned in 1902 to enter the supply business in St. Paul, Minn. He was employed by the Chicago Pneumatic Tool Company for a number of years and in 1910 became western sales manager of the Duff Manufacturing Company. Later he was elected vice-president of the successor company, the Duff-Norton Manufacturing Company.

Grip Nut Company.—*Chester D. Tripp* has been elected president of the Grip Nut Company, Chicago, to succeed *John H. Sharp,* resigned. *Ernest H. Weigman,* of the sales department, has been appointed sales manager. Mr. Tripp has been a member of the board of directors for twenty years. He is an industrial engineer and is associated with a number of other companies either as a director or officer. He has been active in the last two decades in the iron and steel industry, in mining and metallurgy, and in general industrial enterprises.

Ernest H. Weigman, who has been appointed sales manager, was born in De Soto, Mo., on July 29, 1892, and entered

Ernest H. Weigman

railway service in 1909 as a car repairer and inspector on the Louisville & Nashville. From 1910 to 1917 he served as a piecework checker of the Missouri Pacific at St. Louis, Mo., a traveling car inspector of the Great Northern and the Northern Pacific at St. Paul, a traveling instructor for the Atlantic Coast Line, and assistant secretary of the American Railway Master Mechanics' Association and of the Master Car Builders' Association. In August, 1917, he became supervisor of car repairs for the Louisville & Nashville, at Louisville, Ky., and in October, 1925, was appointed master car builder of the Kansas City Southern at Pittsburg, Kan. He resigned from that position on September 1, 1930, to enter the sales department of the Grip Nut Company.

(*Turn to next left-hand page*)

VAPOR CAR HEATING COMPANY.—*James T. Clark,* who has been in charge of sales in the northern territory of the Vapor Car Heating Company, Inc., Chicago, with headquarters at St. Paul, Minn., has been promoted to assistant sales manager, with headquarters at Chicago, and has been succeeded by *Franklin E. Hess,* sales engineer at Chicago. Mr. Clark was born in Dubuque, Iowa, in 1896. In 1912 he entered the employ of the Chicago, Milwaukee, St. Paul & Pacific, and was successively clerk in the car department, car foreman and general car foreman at various points on the road. In 1925, he entered the sales department of the Vapor Company at St. Paul, where he has been in charge of sales in the northwest territory.

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AMERICAN LOCOMOTIVE COMPANY. — *Joseph B. Ennis* has been appointed senior vice-president of the American Locomotive Company, and *James E. Davenport* has been appointed vice-president of engineering, development and research. *William A. Callison,* assistant district sales manager at Chicago, has been appointed district sales manager to succeed *William S. Morris,* who was elected vice-president of the Montreal Locomotive Works, Montreal, Que., last June. *Paul D. Curtis* succeeds Mr. Callison as assistant district manager of the American Locomotive Company at Chicago and continues also as president of the Marquette Railway Supply Company, Chicago.

Joseph B. Ennis began his business career in 1895 as a tracer in the drafting room of the Rogers Locomotive Works. From 1899 to 1902 he held the position of elevation draftsman respectively with

Joseph B. Ennis

the Schenectady Locomotive Works, the Rogers Locomotive Works, and the Cooke Works, American Locomotive Company. In 1902 he was transferred to New York and placed in charge of designs and calculation-specifications for locomotives. In 1906 he was appointed assistant to the mechanical engineer and became successively designing engineer, chief mechanical engineer and, in 1917, vice-president in charge of engineering, which position he held until his present appointment.

James E. Davenport entered railway service in 1909 as a special apprentice at the West Albany shops of the New York Central and remained with that road until 1940. During that time he successively held positions as enginehouse foreman, dynamometer car engineer, train master, division superintendent, assistant to the assistant general manager, assistant to the executive vice-president and assistant chief engineer of motive power and rolling stock. In 1940 he left the New York Central to become assistant vice-president of engineering with the American Locomotive Company, which position he was holding

James E. Davenport

at the time of his recent appointment. During 1927-28 Mr. Davenport was president of the International Railway Fuel Association.

William A. Callison was born on June 17, 1905, at Hinton, W. Va., and was educated at St. John's Military Academy and Purdue University. He was employed in various departments of the Chicago, Indianapolis & Louisville for two years, and later worked in the research department of the International Nickel Company at Huntington, W. Va. In January, 1929, he entered the employ of the American Locomotive Company as a special apprentice and in March, 1931, was transferred

William A. Callison

to the sales department at Chicago. In March, 1940, Mr. Callison became assistant district sales manager.

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FITZWILLIAM SARGENT has been appointed representative of the railroad division of the Edward G. Budd Manufacturing Company, with headquarters at the Philadelphia, Pa., plant. Mr. Sargent, who will be associated with S. M. Felton, eastern sales manager, was with the Standard Supply & Equipment Co. from 1915 to 1930, and was president of that company for three years.

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UNION ASBESTOS & RUBBER CO.—*P. S. Nash,* assistant vice-president of the Union Asbestos & Rubber Company, Chicago, has been placed also in charge of western railroad sales, with headquarters at Chicago. *George L. Green,* eastern sales representative, has been appointed assistant vice-president in charge of eastern railroad sales, with headquarters at Chicago. *J. B. Crawford,* office manager at Chicago, has been appointed service engineer, with headquarters at San Francisco, Calif.

P. S. Nash was formerly in the mechanical department of the Oregon Short Line at Pocatello, Idaho. He joined the Union Asbestos & Rubber Company in 1926, and later was located in Salt Lake City, Utah, and then in San Francisco as sales representative. In August, 1939, he was appointed assistant vice-president at Chicago.

G. L. Green, after his graduation from Yale-Sheffield Scientific School in 1931, was with the Continental-Illinois National Bank & Trust Company. In 1934, he entered the employ of the Union Asbestos & Rubber Company as sales engineer, covering certain portions of the southwestern and also the northwestern territories. In 1939 he was promoted to eastern sales representative.

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JOHN B. WRIGHT, assistant vice-president and district manager of the Westinghouse Air Brake Company, has been ap-

John B. Wright

pointed assistant to the president with headquarters at the general office in Wilmerding, Pa. Mr. Wright entered the service of the company in 1899 as a clerk in the engineering department. Later he became chief clerk of that department, and in 1906 took charge of engineering correspondence at the general office. He became assistant manager of the Pittsburgh district in 1920, and three years later was appointed also assistant to the vice-president, in charge of the commercial engineering division. In 1932 he became assistant vice-president. Mr. Wright now relinquishes this title, but will continue as manager of the Pittsburgh district in addition to his new duties as assistant to the president.

(*Turn to third right-hand page*)

Obituary

J. H. Bendixen, chairman of the board of directors of the Bettendorf Company, died December 3. Mr. Bendixen joined the Bettendorf organization in 1894 as foreman of the machine shops and subsequently held the positions of assistant superintendent, superintendent and general manager. In 1909 he was appointed vice-president of the company, which position he held until his retirement on September 1, 1938.

Harry T. Gilbert, who retired as Chicago district sales manager of the Illinois Steel Company in 1936, died on December 27 at Pass Christian, Miss.

Edward S. Dilley of the Standard Brake Shoe & Foundry Co., Pine Bluff, Ark., died December 15.

Personal Mention

General

Edward Greig Bowie, assistant superintendent of the Western Lines of the Canadian Pacific has been appointed superintendent of the motive power and car departments of the Western lines, with headquarters at Winnipeg, Man.

C. M. Wilburn has been appointed motive-power inspector of the Huntington division of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

Robert A. Pyne, superintendent of motive power and car department of the Western lines of the Canadian Pacific at Winnipeg, Man., retired January 1. Mr. Pyne was born at Toronto, Ont., on April 10, 1874, and entered railway service as a machinist apprentice on the

Robert A. Pyne

Canadian Pacific at Winnipeg in July, 1887, later being promoted successively at that point to machinist, main shop gang foreman, enginehouse shop foreman and assistant general foreman. In July, 1902, he was advanced to general foreman at Calgary, Alta., and in September, 1903, to acting master mechanic. In January, 1904, Mr. Pyne was appointed locomotive foreman at Brandon, Man., and in October, 1906, was promoted to division master mechanic at Moose Jaw, Sask., later being transferred successively to Nelson, B. C., and Calgary, Alta. In January, 1912, he became superintendent of shops at Winnipeg, and in August, 1916, was promoted to superintendent of the motive power and car departments, Eastern lines, with headquarters at Montreal, Que. Mr. Pyne was transferred to the Western lines, with headquarters at Winnipeg, in January, 1921, where he was located until his retirement on January 1.

Master Mechanics Road Foreman

Frank C. Watrous has been appointed trainmaster and road foreman of engines of the Pittsburg & Shawmut, with headquarters at Kittanning, Pa.

Paul Thomas, assistant master mechanic of the Philadelphia division of the Pennsylvania, has been promoted to master mechanic of the Chicago Terminal and Logansport divisions, at Chicago.

T. H. Callahan, traveling engineer on the Southern Pacific lines in Texas and Louisiana, at Victoria, Tex., has been promoted to the position of general road foreman, with headquarters at Houston, Tex.

F. E. Litz, assistant road foreman of engines, Pocahontas division of the Norfolk and Western, has been promoted to road foreman of engines of the same division.

R. N. Booker, district road foreman of engines on the Southern Pacific at Los Angeles, Calif., has become general air-brake inspector and general road foreman of engines, with headquarters at San Francisco, Calif.

William Henry Gimson, general foreman on the St. Louis-San Francisco at Springfield, Mo., has been promoted to master mechanic of the Southwestern and Western divisions, with headquarters at West Tulsa, Okla.

Shop and Enginehouse

John Elsee, foreman in the mechanical department of the Louisville & Nashville at Jackson, Ky., has been transferred to the position of night enginehouse foreman at Ravenna, Ky.

Obituary

Robert Blaine Spencer, master mechanic of the Southwestern and Western divisions of the St. Louis-San Francisco, with headquarters at West Tulsa, Okla., died on December 24 at Claremore, Okla.

Ray M. Brown, assistant to general superintendent of motive power of the New York Central, with headquarters at New York, who retired on December 31, 1940, after 41 years of service, died on January 17, after an illness of six months, at the age of 61.

John Leonard Driscoll, former New York Central fireman and master mechanic of the Catskill Mountain railroad, died at Catskill, N. Y., on January 2, at the age of 103 years. Known as Catskill's "grand old man," Mr. Driscoll started his railway career as a locomotive fireman on the Hudson River railroad (now New York Central) in 1863, and then joined the Dutchess & Columbia and the Poughkeepsie & Eastern (now New York, New Haven & Hartford) as an engineer. When the three-foot gage Catskill Mountain R. R. was opened in 1882, Mr. Driscoll was made superintendent motive power and master mechanic, which positions he held until the abandonment of the road in 1919.

Frederic Methven Whyte, who was for many years general mechanical engineer of the New York Central, died on January 2 at Tarrytown (N. Y.) hospital, after a brief illness, at the age of 75 years. Mr. Whyte was born on March 3, 1865, and was graduated from Franklin Academy in 1884 and Sibley College, Cornell University, in 1889. He entered railway service on May 1, 1889, as a draftsman in the motive power department of the Lake Shore & Michigan Southern (now New York Central), serving in that capacity until January, 1890, when he went with the Baltimore & Ohio and was employed in the testing department and drawing room at Baltimore, Md., until February 1, 1892. Mr. Whyte was engaged in special testing work for the Mexican Central railway at Mexico City from February to June, 1892, and in general railroad engineering in Chicago from June, 1892, to December, 1894, chiefly with the South Side Elevated road, and in railway newspaper work. He was draftsman for the Northwestern Elevated road at Chicago from July, 1895, to September, 1896, when he became consulting engineer at Chicago. Mr. Whyte served as mechanical engineer for the Chicago & North Western and secretary of the Western Railway Club from July 1, 1897, to August 10, 1899, then becoming mechanical engineer for the New York Central & Hudson River (now New York Central). From November 1, 1904, to 1910 he was general mechanical engineer for the same road, the Lake Shore & Michigan Southern, the Boston & Albany, the Lake Erie & Western, and the Indiana, Illinois & Iowa. From September 15, 1905, to 1910, Mr. Whyte was also general mechanical engineer of the Rutland. On November 1, 1911, he went with Hutchins Car Roofing Company as vice-president. In 1921 he was the only American member of the Uniform Gage Commission, appointed by the Australian government to work out a system of unification of railroad gages in Australia. Mr. Whyte retired five years ago.

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